Growing and Managing Site Specific Plants in the Nursery

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Abstract

Cornflower Farms has its own in-house propagation and record keeping techniques for managing multiple site-identified species that are grown for either contract or open markets concurrently. These techniques help ensure that quality plant materials will be produced in the right quantity and on-time. This paper describes these techniques which are twenty years in the making and still evolving.

Keywords

contract growing, site identified plant material, record keeping, stratification, native plant propagation

Introduction

Cornflower Farms began as a small propagation nursery with an emphasis on natives. Managing projects 20 years ago was simple. A couple of three-ring binders of notes, a lot of tribal knowledge and only a few small projects made it relatively easy to keep things straight. As the nursery grew, so did the number and size of projects and people involved. As we grew a protocol and information system evolved to help manage our quickly accumulating knowledge. This presentation will describe our current propagation and management tools.

Our overall goal is to produce a healthy well-adapted plant that is ready for the rigors of the wild. To accomplish this goal, a variety of tools are employed including collecting site-specific plant materials and using special containers, soil mixes, microbial inoculants and other aids.

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The contractual aspect of our operation demands, for every project, that we meet or exceed the number of container-grown plant materials required and that they be delivered on time. Coordinating propagation and production for as many as 50 species for a single project takes skill and precise record keeping and planning by our production team. Our nursery can have as many as fifty sizable growing contracts per year. We also produce sizable numbers of site-identified open stock from plant communities from all over Central and Northern California. Coordination of collections, materials, and labor is demanding and requires a fair amount of fine-tuning.

The diversity of project locations and associated plant communities is great. It can include those from salt marshes in San Francisco Bay, riparian projects in the Central Valley, mitigation for endangered plants in the Sierra foothill, high elevation projects in the Tahoe Basin and the East and West slopes of entire Sierra Nevada Range extending to the southern Cascades. This requires that we provide a large variety of suitable growing climates by micromanaging our nursery growing areas to best meet the unique and specific needs of all these associated plant materials.

Every year we do our plant projections to fill both our project and open stock needs for over 800 different plants. These projections help us produce a collection calendar for the entire year. This calendar is a great aid for tracking and coordinating the large number of sites that we collect from each year. It, in turn, creates the production calendar that establishes stratification, sowing, cutting, and production potting schedules.

Methods

Setting projections

Projection numbers are prepared in the summer/fall of the year before plant materials are needed in order that seed and cutting collection amounts can be determined. Order forms are mailed in August to our regular customers and are returned within 30 days. Sales totals from the previous year are evaluated to determine the quantity of open stock we want to produce by specie. Anticipating potential near-term needs for a given region is a skill in itself . It requires familiarity with potential collection locations and assimilating information acquired through phone contacts, requests for bids and awareness of development activities in the region. This information, although helpful in determining how much of a given plant specie might be needed from each collection region, can still result in over/under production and is inherently risky. All this information is tabulated and entered into our database with the previous year's records showing projections and actual plant numbers produced.

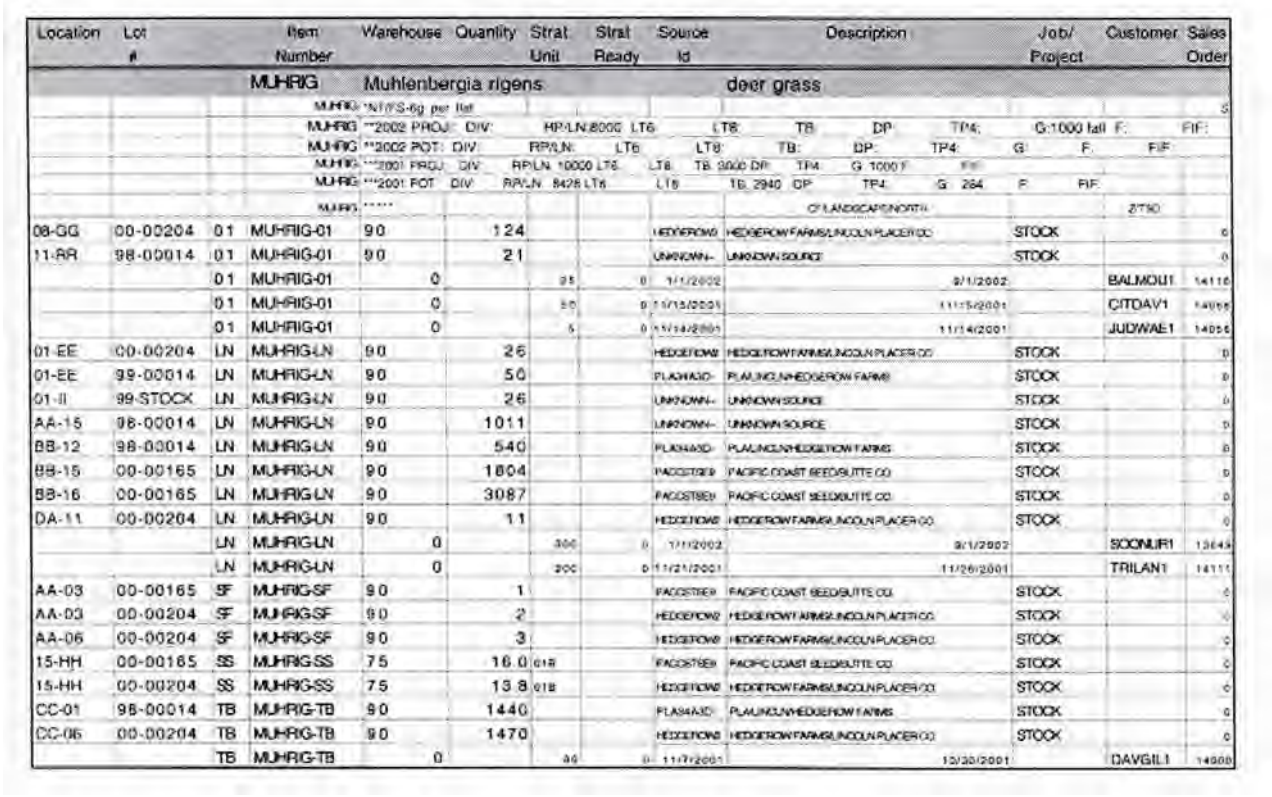
We have developed a simple but large plant information database that documents both our successes and failures in propagation. Information on rooting percentages, propagation timing and other critical factors, cultural needs, fertilization requirements, preferred soil mix, container preferences among other factors is recorded. At present we keep this information in a simple spreadsheet format and specific information is transferred to worksheets for use by production staff as needed. This data combined with our current inventory and order data gives us a fairly accurate snapshot view of plant production requirements for the coming year (Figure 1).

In the year 2000, we implemented a new accounting computer program; Flexware; that was customized to track our specialized inventory as well as provide inventory history. We are currently developing a complementary production module that will allow us to efficiently store all plant data and more efficiently transfer specific production information to work sheets as-needed and to help coordinate production calendars and eliminate duplication of paper trails.

Production calendar

Once we have our goals set, we can start our production calendar. In June our collection calendar is prepared. A breakdown of collection locations for both projects and open stock arc made. Collection permits at various locations are procured.

Amounts of plant materials to be collected per specie are estimated for each region. Approximate time of collection



Location	Lot #		Item Number	Warehouse	Quantity	Strat Unit	Strat Ready	Source Id	Description	Job/ Project	Customer	Sales Order
			MUHRIG	Muhlenbergia rigens					deer grass			
			MUHRIG	***2002 PROJ	DIV:	RP/LN:8000	LT6:	LT8:	TB: DP: TP4:	G:1000 fall	F:	FIF:
			MUHRIG	***2002 POT	DIV:	RP/LN:	LT6:	LT8:	TB: DP: TP4:	G:	F:	FIF:
			MUHRIG	***2001 PROJ	DIV:	RP/LN: 10000	LT6:	LT8:	TB: 9000 DP: TP4: G: 1000 F:	FIF:		
			MUHRIG	***2001 POT	DIV:	RP/LN: 8426	LT6:	LT8:	TB: 2940 DP: TP4: G: 264	F:	FIF:	
			MUHRIG	*****					CF LANDSCAPE/NORTH		ZITSO	
08-GG	00-00204	01	MUHRIG-01	90	124			HEDGEROW2	HEDGEROW FARMS/LINCOLN PLACER CO	STOCK		0
11-RR	98-00014	01	MUHRIG-01	90	21			UNKNOWN-	UNKNOWN SOURCE	STOCK		0
		01	MUHRIG-01	0		95	0	1/1/2002	9/1/2002		BALMOU1	14116
		01	MUHRIG-01	0		50	0	11/15/2001	11/15/2001		CITDAV1	14095
		01	MUHRIG-01	0		5	0	11/14/2001	11/14/2001		JUDWAE1	14056
01-EE	00-00204	LN	MUHRIG-LN	90	26			HEDGEROW2	HEDGEROW FARMS/LINCOLN PLACER CO	STOCK		0
01-EE	99-00014	LN	MUHRIG-LN	90	50			PLASHASO-	PLA/LINCOLN/HEDGEROW FARMS	STOCK		0
01-II	99-STOCK	LN	MUHRIG-LN	90	26			UNKNOWN-	UNKNOWN SOURCE	STOCK		0
AA-15	98-00014	LN	MUHRIG-LN	90	1011			UNKNOWN-	UNKNOWN SOURCE	STOCK		0
BB-12	98-00014	LN	MUHRIG-LN	90	540			PLASHASO-	PLA/LINCOLN/HEDGEROW FARMS	STOCK		0
BB-15	00-00165	LN	MUHRIG-LN	90	1804			PACOST6E9	PACIFIC COAST SEED/SUTTE CO	STOCK		0
BB-16	00-00165	LN	MUHRIG-LN	90	3087			PACOST6E9	PACIFIC COAST SEED/SUTTE CO	STOCK		0
DA-11	00-00204	LN	MUHRIG-LN	90	11			HEDGEROW2	HEDGEROW FARMS/LINCOLN PLACER CO	STOCK		0
		LN	MUHRIG-LN	0		300	0	1/1/2002	9/1/2002		SOONUR1	13645
		LN	MUHRIG-LN	0		200	0	11/21/2001	11/26/2001		TRILAN1	14111
AA-03	00-00165	SF	MUHRIG-SF	90	1			PACOST6E9	PACIFIC COAST SEED/SUTTE CO	STOCK		0
AA-03	00-00204	SF	MUHRIG-SF	90	2			HEDGEROW2	HEDGEROW FARMS/LINCOLN PLACER CO	STOCK		0
AA-06	00-00204	SF	MUHRIG-SF	90	3			HEDGEROW2	HEDGEROW FARMS/LINCOLN PLACER CO	STOCK		0
15-HH	00-00165	SS	MUHRIG-SS	75	16.0	018		PACOST6E9	PACIFIC COAST SEED/SUTTE CO	STOCK		0
15-HH	00-00204	SS	MUHRIG-SS	75	13.8	018		HEDGEROW2	HEDGEROW FARMS/LINCOLN PLACER CO	STOCK		0
CC-01	98-00014	TB	MUHRIG-TB	90	1440			PLASHASO-	PLA/LINCOLN/HEDGEROW FARMS	STOCK		0
CC-06	00-00204	TB	MUHRIG-TB	90	1470			HEDGEROW2	HEDGEROW FARMS/LINCOLN PLACER CO	STOCK		0
		TB	MUHRIG-TB	0		84	0	11/7/2001	12/30/2001		DAVGIL1	14000

Figure 1. Projecrions and Inventory

is noted in our records are adjusted accordingly depending on weather conditions prevailing during the current year. We do 75% of our own collections. For the remaining 25% we use experienced collectors who have special knowledge of a specific area like the Sierras or Tahoe Basin. All new collectors are first met with in the field to best ensure we obtain the seed quality and diversity that we desire. In the fall it is hard to be at all the locations at the same time to collect ripe seeds before animals or weather conditions remove or damage the crop. All of this information is put into a spreadsheet that can be sorted by seed, collection, collector and date to be collected. This now can be put in a calendar format for collection and seed orders can be sent to our outside collectors so they can plan for our numbers.

Collection

We consider a variety of factors when determining the suitability of plant materials found in the field for collection We do a field slice test to determine the quality and ripeness of the seed from a tree or bush. Overall health of the collection plant is evaluated. For example, for *Heteomeles arbutifolia;* toyon; we look for specimens which are free of apple scab and leaf spot. "Trueness" of a plant specie is often determined by its location and surroundings. Was it a "planted native" with an unknown source or a natural accruing one? Is there non native species located that can cross with it and compromise the seed crop seed? This is particularly true with *Platanus racemosa;* western sycamore; and *Platanus occidentalis;* American sycamore. Furthermore we do multiple plant collections of a specie in an area to ensure genetic diversity.

Logging In and seed cleaning

Propagation has become a business of managing many numbers. Every plant that comes into the nursery is tracked numerically during its entire life at the nursery. All materials are assigned a Lot number (indicating year and numeric order of collection), location (which changes as the plant moves through the various stages of propagation at the nursery), Source ID code

(giving the coordinates of the collection site), Customer ID code and Jobl Project ID code. An example can be seen in Figure 2.

In the case illustrated by Figure 2, the seed is located in area 14, the walk-in cooler bin A. The lot number 00 means the material was collected in 2000 and -00316 means it was the 316th entry for the year. Warehouse 75 means it has been cleaned; the customer is Pinnacles National Monument. The project is located at the Pinnacles; and our collection location is San Benito County with the given map coordinates.

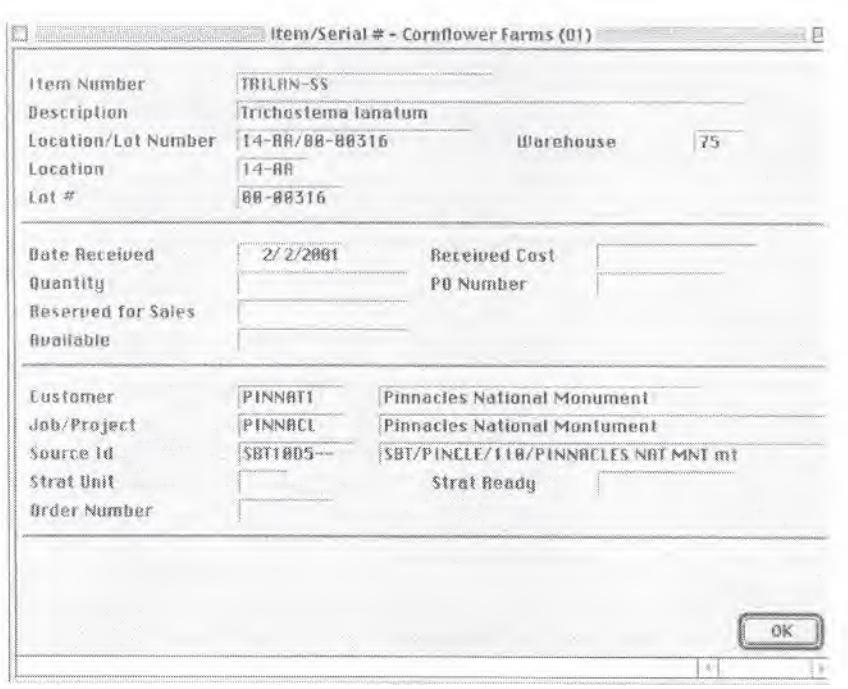


Figure 2. Data Entry Screen

When new seed comes into the nursery, a Seed Data Sheet is completed using our own firsthand information or from an outside collector. Seed Data Sheet information includes collection location, altitude, area temperature range, orientation of plant and site conditions, and seed zone of the site. A Lot Number is assigned to the each collection of a species that follows it through its life at the nursery and beyond. We have had clients call several years later after obtaining one of our propagules needing to find out the original source of the plant. Our records can be retrieved if the client must follow landscape specifications for site identified material at sometime in the future. A Source ID is given to track the exact map coordinates of the collected species. The seed is then entered into the computer with all of its data as new inventory. As the seed is cleaned, stratified, sown or transplanted this information will follow along on all labels, in the database and all of the way to the final invoice.

Pre-treatment, stratification and sowing calendar

After all of our seeds have been collected, cleaned and in storage we make up the Statification and Sowing Calendar. All of the stored seed inventory is exported from the computer into a spreadsheet and combined with our plant information database and sorted to determine timing for a seed going into stratification and flat sowing. Generally we want seeds ready for sowing into flats or containers starting March 1st. The computer sorting groups the seeds into 4 start dates:

November = 3 month stratification and warm/cold combined stratification

December = 2 month stratification

January = I month stratification

February/ March = seed sown directly into flats that do not need to be stratified

Seeds will be coming out of stratification from February through March to be either direct sown into containers or into seed flats for future transplanting.

Pretreatments, such as acid treatments to breakdown a seed coat, are completed before a seed is stratified. Seed is prepared for stratification by soaking it in water for 24 hours then mixing it with a slightly moist course perlite or peat moss depending on the seed. It is them put into a zip lock bag with a breather straw or, as for larger seeds, put into a 13 gallon capacity white plastic bag with I" tube tied into the top so the seeds can

breath. Every two weeks the inventory of seeds in the cooler is exported to a spreadsheet and a cooler status is performed. Each seed bag is gone through, the moisture level is adjusted, disease problems noted and, if necessary, treated and inspected for the emergence of radicals. These reports are used to start preparing worksheets for sowing and to update the projects progress report. If a problem is detected early we will often have enough time to redo seed pretreatments so that order-specified plant numbers can still be met. The seed planning process is always changing as new orders are placed and seed failures occur.

Labeling

Extensive labeling of plants is critical in order to successfully keep various lot numbers and different projects with the same species from getting mixed. Our labels will have all of the information that is tracked with the seed or cutting on it. Projects are given colored label combination that, at a glance, any employee can readily make the distinction what is part of one order and what is not. When over 50 site identified projects are ongoing, we can have color codes combining up to three color labels.

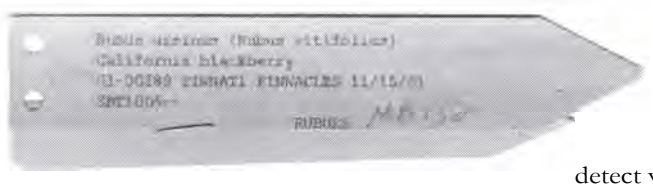


Figure 3. Label

Specialized Growing Practices

We have developed specialized growing techniques to best deal with the wide diversity of materials we propagate. This includes optimum timing for cutting production in the greenhouse, fine tuning seed pretreatment and propagation timing, as well as creating the right environment for the plant to grow on.

The wide range of plant communities that we propagate selected species requires that we often perform micromanagement techniques and provide microclimates for sensitive crops. Our summer temperatures often reach 100-108° E Black containers can produce extremely high soil temperatures and imprecise watering can cause root diseases. Inappropriate placement of a given specie in the nursery can also result in root or foliar disease problems. Overhead watering on some species can cause leaf spot, scab, powdery mildew, or worse, downey mildew. We strive to use preventative measures and adhere to strict sanitation practices. Training of employees and assigning one person to the task of spot watering of sensitive crops is also important. For many species we grow it is important to know the minimum amount of water a plant can grow with. Employees must also need to detect when a potential problem is developing such as leaf color changes or new growth shows stress or distortion.

Bilingual signage and training on sanitation and plant specific watering methods is very important for many of these materials to be successfully produced. We have created areas that are watered from below with capillary mats for plants that are susceptible to foliar disease problems in summer from overhead irrigation. We group plants that need to be on the dry side, need good drainage, and reprieve from the 100 degree plus days. Many of our growing areas are equipped with a manually retractable shade cloth (generally 55% - 63% that can be drawn at transplanting then opened after a short but potentially lethal transplant shock period has past. It can also be used for those short intervals when temperatures soar over 105, especially for crops prone to root disease. Managing a project means daily hands-on attention and fine-tuning by the grower.

The selection of containers used in restoration growing can be critical. The end goal for all of us is to produce an excellent root system void of circling roots. Over the years Cornflower Farms has promoted unconventional containers other than 1 and 5 gallons that were the norm for projects 10 - 20 years ago. Working with the contracting agents over the years, the containers we originally promoted have now become the norm on most bid specifications. Over the years we have worked with the container producers to add features to these containers to increase air pruning and directing roots downward to further reduce problems with circling or pig

tailing roots in the drain holes. Intermediate steps in propagation for materials destined for shifting to larger size containers are important. Transplants with circling roots may not be detected in a final root ball but can be the demise of a plant 10 years after outplanting.

Contract Growing

How are contract grown site identified projects handled within the mainstream of production? On the onset of a new project a contract is drawn defining the specifics of the job. This helps keep a clearer picture in-mind for us and the client on the terms that were agreed upon up-front to apply throughout the term of the contract. We require a 50% deposit to start a contract. This covers the early stages of material purchasing and labor to initiate the project. Each project has a binder set up that records all of the plant progress reports at their various stages and communications with the client. Each plant is given a Plant Sheet where every step for that species is documented from number of cuttings, rooting percentages, transplanting timing, etc. A collection strategy is created for the project and broken down into how many collections, for what species and at what time. Materials are produced in excess from between 30-50% over final numbers through every stage of propagation. Final sorting of a project will release only the most vigorous and finished plants. Production timing is worked derived by looking 'backwards'; starting from the estimated shipping date to insure that the plants will be of size and not overgrown.

Delays are common on restoration projects so the probability of this happening as the project progresses is always considered when transplanting into the final container. We communicate often with the client on timing. Production timing is also determined by where the project is going. High elevation projects need 18 months to collect, stratify and finish a plant before the snows fall. Lower elevation projects we need less time; 12-14 months, and are usually synchronized for planting with the first significant rain (October to December).

Some bids are released too late due to contract release delays to grow and deliver when desired. We have developed special relationships with some repeat clients to allow us to anticipate projects coming down the pipeline. We try to advise them, for instance, what seeds that will need to be collected prior to initiation of the contract in order to fulfill their orders.

Conclusion

Producing plants that will flourish in the rigors of the wild is the ultimate goal for any restoration grower. New research and methods *need* to be reported on regularly as they are developed. Meetings such as this symposium are often the best way to keep on top of developments in growing techniques. Although we are becoming evermore-proficient managers of numbers, we will be in awe of the subtleties of plant propagation forever!