California Weed Science Society

Journal

Information on Weeds and Weed Control from the California Weed Science Society

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IN THIS ISSUE

Introduction

Steve Fennimore, Editor

Hello to California weed managers. As I write this in mid-June I am sure everyone is hitting their stride during the busiest time of the year. I have been thinking about the diversity of our roles and how our discipline has changed since I first got involved in weed science back in 1980. Members of our society work in crop and non-crop weed management, on roadsides and in city parks, golf courses, orchards, croplands and forests. We use herbicides, soil disinfestants, cultural practices and tillage to manage weeds. Out of this diversity there is one thing we have in common, we are all professional and want to do a good job in managing weeds and minimizing our impact on the environment. The purpose of this Journal is to provide a window on the activities of our members, new ideas and information as well as introduce new members of our society. As always I welcome your comments, suggestions and articles. I can be reached at 831-755-2896 or safennimore@ucdavis.edu.

For mailing address changes, please call the CWSS office at 831-442-0883 or by mail at CWSS, P.O. Box 3073, Salinas, CA 93919-3073.

Introducing Brenna Aegerter

U.C. Cooperative Extension, San Joaquin County

I joined UC Cooperative Extension in October 2005 as a Farm Advisor for vegetable crops in San Joaquin County. Primary vegetable crops here in SJ County are processing and fresh market tomatoes, asparagus, pumpkins, potatoes, sweet corn, onions, and watermelon. We also have cucumbers for pickling, bell peppers, and a variety of other vegetables. Total vegetable acreage in 2006 was 86,700 acres.

Previously I trained and worked at UC Davis with plant pathologists Mike Davis and Tom Gordon, conducting field and laboratory research and diagnosing problems in field and vegetable crops from samples submitted from across the state. Common problems were viral, bacterial, and fungal diseases, insect injury, nutrient problems and other abiotic disorders.

In my new position, I am of course responsible for all aspects of vegetable production and have been learning a lot about the other challenges to crop production besides diseases! During these past two seasons I was initiated into the world of weed control field trials by conducting four weed experiments in onions with mentoring from Don Colbert, Bob Mullen, and Mick Canevari. In the future I expect I will be working on weed control in other crops as well.

Looking forward to working with you on projects that might be of mutual interest!

Introducing Hugh Smith

U.C. Cooperative Extension, Santa Barbara County

Hugh Smith joined the UCCE office in Santa Maria in December 2006 as the Vegetable and Strawberry Farm Advisor for Santa Barbara and San Luis Obispo Counties. His position involves assisting growers with diagnosis, outreach, and research to address crop production problems and opportunities.

Hugh received a doctorate in entomology from the University of Florida in 1999. He worked in crop protection and farmer outreach in Florida, the Pacific and Central America before coming to Salinas in 2005 to work for UCCE farm advisor Bill Chaney on conservation biological control of aphids in organically grown lettuce.

Hugh's research projects in 2007 include an evaluation of insectary crops to enhance biological control of broccoli and celery pests when insecticide use on these crops is reduced. Hugh can be reached at 805-934-6247, email: hasmith@ucdavis.edu.

New Problematic and Unusual Weed Introductions Affecting Southern California

Joseph M. DiTomaso. University of California, Davis, jmditomaso@ucdavis.edu

There are a number of important invasive species that severely impact wildlands, rangelands, coast dunes and prairies, and riparian areas of Southern California. Among these include

- poison-hemlock (*Conium maculatum*),
- fennel (*Foeniculum vulgare*),
- Malta starthistle or tocalote (*Centaurea melitensis*),
- artichoke thistle (*Cynara cardunculus*),
- shortpod mustard (*Hirschfeldia incana*),
- saltcedar (*Tamarix ramosissima*), and
- perennial grasses such as giant reed (*Arundo donax*), pampasgrass (*Cortaderia selloana*), and crimson fountaingrass (*Pennisetum setaceum*).

These species, for the most part, are very common and easily recognizable. However, there are many other species that are either locally problematic or have the potential to greatly expand their ranges in the southern regions of the state. Some of these are listed in Table 1. For more information on each of these plants, see DiTomaso and Healy (2007).

Table 1. More obscure invasive species or problematic roadside species in southern California and their ranking on the statewide California Invasive Plant Council's (Cal-IPC) inventory.

Species	Common name	Family	Cal-IPC (2006) list
Dicots			
Mesembryanthemum crystallinum	Crystalline iceplant	Aizoaceae	Moderate Alert
Brassica tournefortii	Saharan or African mustard	Brassicaceae	High
Euphorbia terracina	Carnation spurge	Euphorbiaceae	Moderate Alert
Ricinus communis	Castor bean	Euphorbiaceae	Limited
Monocots			
Phoenix canariensis	Canary Island date palm	Arecaceae	Limited
Washingtonia robusta	Mexican fan palm	Arecaceae	Moderate Alert
Asphodelus fistulosus	Onionweed	Liliaceae	Moderate Alert
Phragmites australis	Common reed	Poaceae	Unable to score because of native congenerics

Crystalline iceplant

South African native that is a trailing annual, biennial or even sometimes a short-lived perennial. The plant has two distinctly different leaf types. The young leaves are heart-shaped and much larger than the ovate or spatula-shaped mature leaves. Crystalline iceplant foliage is covered with glistening water-filled papillae. The flowers are white but turn pink with age. The capsules open when moistened. This species is common on coastal bluffs and other disturbed sites in coastal California, Catalina and the Channel Islands. It appears to be expanding its range and can form dense spreading mats in coastal dunes. When it ages and senesces the increased organic matter can lead to the establishment of other non-native weeds that typically are not adapted to native undisturbed dunes and bluffs.

Saharan or African mustard

Saharan mustard is a winter annual. Despite the common name, it is considered native to the Mediterranean region. In recent years, it has spread rapidly in the Sonoran Desert, including the Imperial Valley. This was very evident in the wet spring of 2006 when Saharan mustard became a dominant species in many communities. It can spread from roadsides into washes, drainages, desert shrubland, and sensitive dune areas. In desert communities it forms a continuous fuel source that can increase the fire frequency, cause large scale conflagrations and lead to type conversion of desert scrub to grassland. In some areas, it threatens to aggressively out compete rare desert plant species. Seeds of the plant can disperse much like tumbleweeds, when dried plant stems break at ground level and tumble under windy conditions. The plant is well adapted to desert climates and its seeds can become sticky with mucilage when moistened with water. This allows the seed to hold water longer and to survive following germination. Control of Saharan mustard is similar to many other mustards. The ALS (acetolactate synthase) inhibiting herbicides such as chlorsulfuron, metsulfuron, sulfometuron and imazapic can effectively control the plant.

Carnation spurge

A relatively uncommon perennial weed in southern California. Carnation spurge is native to southern Europe and the Mediterranean and was introduced to the state in the mid-1980s. Because of its recent introduction, it is not included in the most current California floras. It appears to be spreading rapidly and can form dense patches that increase after fire. The species is very common on the coastal bluffs near Malibu, but can also be found in grasslands, dunes, salt marshes, riparian areas, and oak woodlands in other regions of Los Angeles County. Although it prefers disturbed sites, carnation spurge can also invade relatively undisturbed habitat. The sap has been reported to be toxic, and may cause dermatitis. Control of the weed can be achieved with treatments of triclopyr, chlorsulfuron or glyphosate.

Fig. 1. Castor bean.

Castor bean

Castor bean has a long history as both a medicinal and toxic plant (Fig. 1). It is native to tropical Africa and Eurasia and can be a herbaceous perennial or even a small tree to 10 feet tall. Although some varieties are cultivated as ornamentals or even for their seed oil, the species has escaped cultivation in many locations in the central and south coast of California and has become a common roadside, railway and wildland invasive. The plant is well adapted to dry areas. The seed caruncle absorbs water which enhances germination under conditions that would otherwise be too dry for most competing vegetation. The toxicity of the plant is well recognized and can kill both animals and humans. The toxic, a proteolytic enzyme known as ricin, is primarily concentrated in the seeds, although the foliage can also contain the poison.

Ingestion of about 4-8 seeds by an adult can be lethal and even fewer can kill a child. Castor oil, which is also derived from seeds, does not contain the water-soluble toxin. Ricin is considered one of the most toxic substances produced by plants and can kill a human when injected into the blood system at 0.0001 mg/kg of body weight (Kingsbury 1964). The compound has been used by the former Russian KGB to commit murder by injecting ricin into victims using an umbrella with a hypodermis needle attached at the tip. Handling castor bean foliage can also cause a severe contact dermatitis and the disagreeable odor of the plant accounts for its avoidance by foraging animals. Livestock poisonings can occur when feed is contaminated with castor bean seeds. Control of castor bean has been reported with glyphosate or growth regulator herbicides.

Canary Island date palm and Mexican fan palm

Both these palms are commonly cultivated as landscape ornamentals. However, they have regularly escaped into urban areas, orchards, and natural riparian stream and river corridors where they are typically found as young plants. Although they occur in many regions of the state, they are much more common in southern California. They have particularly become a problem in natural riparian stream and river corridors near residential areas, orchard crops, and as seedlings that volunteer in landscaped areas. As is indicated by the common name, Canary Island date palm is native to the Canary Islands and Mexican fan palm is native to central Mexico, but not the northern mountain deserts. Birds routinely feed on the fruit and can disperse the seed with their droppings. For this reason, infestations are common under taller vegetation or telephone wires and other tall structures. In addition, the seeds are large and readily carried by winter rains from landscaped areas down storm drains into nearby creeks and rivers. Control is difficult because the thick waxy cuticle on the leaves prevents herbicide absorption. However, imazapyr has been shown to be an effective management option for smaller plants.

Onionweed

Onionweed is an annual to short-lived perennial with thick tuber-like stem bases. It is native to southern Europe and was introduced to the United States as a garden ornamental. Although the common name contains the word onion, it does not have the characteristic odor or taste of onion or garlic when crushed. It can also be found in pastures and rangelands in Australia, where it is avoided by livestock. In Australia, onionweed is a government-listed noxious weed. In California, it is rapidly spreading along the southern and central coast where it can form dense populations that exclude grasses and other desirable forage species. Control of the species is considered very difficult. Australians have reported 2,4-D to be somewhat effective, but in California a 5% solution of glyphosate has been used in control efforts.

Common reed

Common reed is more often referred to as *Phragmites*. Although its current scientific name is *Phragmites australis*, it is commonly listed in the literature as *Phragmites communis*. The species is a widespread native perennial grass of the United States, including California, where it is a desirable component of natural aquatic ecosystems such as marshes, and borders of lakes, ponds, and rivers. An invasive ecotype from Europe was first introduced to the eastern United States about 150 years ago and has spread rapidly throughout the country, but particularly in the eastern states. Genetic studies show it to be more aggressive than the native biotypes and is capable of spreading into new areas and plant communities. It is considerably more salt tolerant than the native ecotype and, as a result, has invaded more saline areas of the coast. In the eastern United States, it is replacing the native *Spartina* communities and it may do the same in the west coast. It is very difficult to distinguish the European from the native North American biotypes. The main distinguishing characteristic is the length of the ligule, which is very small in both biotypes. For some, it is even difficult to distinguish common reed from giant reed (*Arundo donax*). Unlike giant reed, common reed produces viable seed.

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Soil Disinfestation: Seed control vs. Weed control

Steve Fennimore, University of California, Davis

With the struggle to find replacements for methyl bromide, to reduce volatile organic compounds (VOCs) and to find new weed control tools for specialty crops, it is appropriate to pause and think what it is we seek to accomplish when we perform "weed control" operations. With most weed control tools such as herbicides, cultivators, tillage equipment, hoes, propane flaming and hand weeding, we are actually killing weeds after the weed seed germinates. For example, a weed that emerges a day after a paraquat application is perfectly healthy because paraquat has no soil activity and does not kill any weed seeds in the soil seedbank. Preemergence herbicides with soil activity, such as oxyfluorfen, have no effect on the weed seedbank and act only on weed seedlings *after* they germinate.

The only tools that can kill a weed seed in the seedbank are heat and fumigants – tools that create temporary lethal conditions in the soil. Heat from solarization with clear tarp and moist soil or heat from a steam generator kills viable weed seeds in the soil by "cooking" the seeds (Fig. 2). Fumigants such as methyl bromide, 1,3-dichloropropene + chloropicrin (Telone C35) and metam sodium (Sectagon, Vapam) also kill weed seeds in the soil by creating a temporary lethal condition in the soil (Fig. 3). Heat and fumigants are therefore used to disinfest soil of weed seeds as well as pathogens and nematodes. With disinfestants the lethal conditions in the soil created by heat or fumigants must be allowed to dissipate so that conditions are not lethal at the time the crop is planted. With heat the soil simply must be allowed to cool. For solarization one simply removes the clear mulch or paints it white to stop solar heating of the soil, and to stop steam heat simply turn off the steam. With fumigants it is more complex as the fumigant must be present in the soil in lethal concentrations long enough to kill the weed seeds. After killing the weed seeds, the fumigant degrades and/or dissipates into the air so that by 1 to 4 weeks after application the field can be planted. *It is the dissipation into the air that has caused problems for fumigants with the VOC regulations due to the fact that too many fumigant volatiles escape into the atmosphere.*

After the disinfestation process has been completed the crop can be planted in soil that has been cleaned of viable weed seeds. The "residual" effect of soil disinfestation, that is season long weed control, occurs because of the depletion of viable weed seeds in the soil seedbank. However soil disinfestation has no "residual" activity as would be true of an herbicide with soil activity. A fumigated or solarized field can quickly be reinfested with wind-blown weed seeds such as common groundsel or hairy fleabane which is why these weeds are so troublesome in crops grown on fumigated soils.

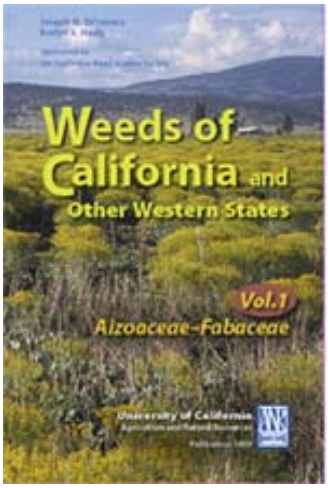
One more concept to introduce is that of depletion of the soil seedbank. Depletion is the cleaning of the weed seedbank either by using a soil fumigant or heat to quickly kill the seedbank, or by carefully preventing weeds from setting seed over a period of several years so that eventually nearly all of the weed seed in the seedbank are depleted. Soil disinfestation is fast but depletion of the seedbank with herbicides, tillage and cultural practices takes several years to conduct. Either way when a field has a relatively clean weed seedbank it requires constant effort to maintain this clean status, as a short period of lax weed control will allow the field to quickly be reinfested.

Fig. 2. Soil solarization of strawberry beds.

Fig. 3. Soil fumigation prior to strawberry planting.

Weeds of California and Other Western States: The Making of the Book

Joseph M. DiTomaso. University of California, Davis, jmditomaso@ucdavis.edu



There are three previously published weed identification books or manuals that have been widely used in California. The first was published around 1951 by W. W. Robbins, M. K. Bellue, and W.S. Ball and was entitled *Weeds of California*. A second edition of this book was published in 1970. Dr. Robbins was considered the first Weed Scientist in the United States and the Weed Science program at the University of California, Davis, is housed in a building named in his honor. In 1977, a second three-ring-binder weed guide to California was developed by the Fresno County Farm Advisor Bill Fischer, with help from June McCaskill and Dr. Art Lange. The *Growers' Weed Identification Handbook* (Fischer et al. 1977) primarily covered agricultural weeds of California. Most recently, the book entitled *Weeds of the West* by Tom Whitson and other western Weed Scientists (Whitson 1996) has become widely used. All of these books cover the most common weeds of the region.

While at Cornell University, my colleagues Drs. Rick Uva, Joe Neal and I published the *Weeds of the Northeast* (Uva et al. 1997). This book provided considerable detail on the identification and biology of about 300 weeds of the northeastern United States. In early 2007, in collaboration with Evelyn Healy, we published the most comprehensive weed identification guide yet produced in California or the United States entitled *Weeds of California and Other Western States* (DiTomaso and Healy 2007). This book was modeled after the *Weeds of the Northeast.* The production and statistics associated with this book are the focus of this paper.

Timetable and Collaborations

In 1997, the preliminary organization of the *Weeds of California* was initiated at the California Weed Science Society (CWSS) conference in collaboration with many UC Farm Advisors, Specialists and other faculty. At this meeting we determined what weed species to include within the book. Later that summer, the CWSS Board of Directors agreed to assist in the funding of the project by providing two years of support to hire a writer (Evelyn Healy). As a result, they are officially recognized as the sponsor of both this and the first aquatic weeds identification book. Initially it was felt that the book would be completed by 2001. In reality, the book took considerably more time than was estimated. In this particular case, my naivety on the time commitment was probably an advantage, as I may not have initiated the project with early knowledge that the book would not be completed until the end of 2006.

To undertake such a massive project requires a considerable amount of good fortune and many outstanding individuals to assist in the process. In the case of this book, I was extremely fortunate to be surrounded by high quality professionals. To complete this project required that all the stars line up, and I had many stars to help in the process.

The financial support by the CWSS Board was imperative to the preliminary work. Employing someone as dedicated and with the perseverance of Evelyn Healy was critical to the success of the project. Evelyn researched each group to be included in both the *Aquatic and Riparian Weeds of the West* and *Weeds of California and Other Western States* book. Each entry required about a week to research and write and she wrote approximately 300 separate entries for the two books combined.

In addition to Evelyn's skills, we were very fortunate to be able to work with and learn from the nationally recognized talents of the UC DANR principal photographer Jack Kelly Clark. Jack not only taught me the basics of photography, but also provided many of the slides, and processed most of the photos using Photoshop. Jim O'Brien was also temporarily employed by UC DANR to do the close-up photography of most of the seeds and his photos are spectacular.

Dr. Ellen Dean, the director and now curator of the UC Davis Herbarium, was a tremendous help to Evelyn and me on the identification of many weeds in the state. Our access to the herbarium was invaluable. The UC Davis Herbarium is known for its collection of weeds specimens, which was exactly what was necessary to carry on this project.

In addition to the photographers, the staff at DANR, including Bob Sams (Director), Ann Senuta (Publications Production Manager), Steve Barnett (Senior Editor), Celeste Aida Marquiss (Principal Producer Art Director**)**, Steve Lock (Senior Photographer), Cynthia Kintigh (Marketing Coordinator), and Mike Poe (Media Services Manager) are, in my opinion, the best in the country in their professionalism and quality.

Book Statistics

To produce a book of this size and magnitude required a considerable amount of funding. For example, I procured $350,000 in funding support and DANR invested more than that to produce the book. In total, the book required about $1 million to produce.

It was decided in early 2001 that we would divide the project into two, with the first book published as the *Aquatic and Riparian Weeds of the West.* The widely used *Weeds of the West* book did not include aquatic species and, thus, the aquatic book was felt to be a counterpart to this publication.

In its final form the *Weeds of California and Other Western States* is two volumes, 1808 pages long. The book contains 262 entries (many of which cover several species). The main entries are organized alphabetically by family then genus. In addition, the book contains shortcut identification tables, two keys to grasses (one to vegetative characteristics), a list of non-native plants rarely or occasionally naturalized in California, a glossary, and a 65 page index that covers all common names, scientific names and synonyms. The list of non-native plants rarely or occasionally naturalized plants in the back of the book lists 722 additional species, of which 281 are not listed in The Jepson Manual: Higher Plants of California (Hickman 1993).

Up-to-date information is presented for 812 species. Of these, 451 are discussed in detail in the main entries and an additional 361 are discussed as related species at the end of the main entries. In total, 1534 species are included in the book.

There are over 3,000 color photographs in the two volume set. Of these, most were taken by me on trips across the western United States. I visited every county in California photographing weeds, collecting seeds in the field for later photography and to germinate for seedling photographs. Many of the photos in the book were taken by Jack Kelly Clark from previous outings. Slides were also borrowed from several people, particularly Clyde Elmore, Joe Neal, and CDFA. In the two volume book, there are a total of 657 close-up photographs of seeds, 326 seedling photographs, and 737 total species photographed. Most species are represented by multiple photos.

When the book was completed, it was reviewed by many people. The acknowledgements section of the people that assisted in this project is over a page in length. Each of the 262 entries was reviewed by two to three individuals for a total of 550 to 600 individual reviews. All these comments had to be incorporated into the final version of the text. When all the changes were made, the book was submitted to DANR in November 2003. This submitted form of the book was a 900 page single spaced document that was accompanied by five large binders with the 3000+ slides. The document with just the photo captions was 72 pages long. DANR further sent the completed book and many of the photos to two or three anonymous reviewers for final changes.

The process of designing the books, finalizing the slides presentations, editing and re-editing took an additional three years until its publication date of 2007. The *Aquatic and Riparian Weeds of the West* and the *Weeds of California and Other Western States* compliment the production of the diagnostic CDs to weedy grasses and broadleaf species of California. This combination allows for diagnostic identification of nearly 1000 species and detailed information in the beautifully produced books. All these can be found on the calweeds.com website.

I thank all who contributed to the book and appreciate all the support from the California Weed Science Society.

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2007 California Weed Science Society Scholarship Recipients

Your California Weed Science Society instituted a scholarship program in 2007 for California students interested in weed science. The 2007 CWSS Scholarship recipients from left to right are: James Johnson, CSU Fresno; Paolo Sanguankeo, Cal Poly San Luis Obispo; Louis Boddy, UC Davis, Claudia Marchesi, UC Davis; L. Scott Scheufele, CSU Fresno; Earl Lavagnino, CSU Fresno.

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