"Weeds Just Want to Have Fun!!!"

or

Why Are These 10 Common Container Weeds So Common?: Part 1

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The 10 most common container weeds are listed in Table 1. The four top strategies these weeds use to be included among the 10 most common, will be presented. These four strategies indicate, "Weeds just want to have fun!" Weeds like to travel, they like the water, they like to wear disguises and they like to just hang-out. Weeds in your containers and container yards, have done all their planning, have their "ducks in a row," and are now just "chilling." The acronym for the four strategies for fun is **DSWW**: 1) "***D****ifficult to Control"* - which comprises issues regarding proper herbicide selection, hand weeding and pseudo-dormancies; 2) "**S**heer Numbers" - consisting of extensive seed production abilities and effective dispersal mechanisms; 3) "***W****eed Seed Continuum*" - involves the six lifecycles of weeds and which lifecycle(s) container weeds predominate, the corresponding timing of herbicide applications and the consideration of herbicide dose response within weed species; and, 4) "***W****e Like It Here*" - the heat and/or nutrient and water rich environment of the containers, is just the place where weeds want to live and raise a family! The top 10 weeds will be listed according to which **D, S, W** or **W** strategies best illustrates their rise to predominance in nursery containers. In this article we will discuss the first 5 in Table 1, in part 2 of this article we will discuss weeds number 6-10.

Table 1. Common nursery container weeds listed by family and life cycle. The strategies of DSWW that have the species uses *most* predominantly are indicated. Note: "D" indicates "difficult to control", "S" indicates "sheer numbers", the first W or "W_1" indicates some strategy the species is using in the continuum of "weed seed emergence", and the second W or "W_2" indicates the species is utilizing a strategy of "we like it here" or exploitation of the container environment.

Common name	Scientific name	Division or family	Life cycle	Strategy
1. a) Hairy bittercress	*Cardamine hirsuta*	Brassicaceae	Winter annual	D,S,W_1,W_2
b) Pennsylvania bittercress	*Cardamine pennsylvanica*	Brassicaceae	Winter annual/ biennial	D,S,W_1,W_2
2. Prostrate spurge	*Chamaescyce maculata* or *Eurphorbia maculata*	Eurphorbiaceae	Summer annual	S,W_1, W_2
3. Horseweed or marestail	*Conyza canadensis*	Asteraceae	Summer and	S,W_1

			winter annual	
4. Northern willowherb	*Epilobium ciliatum*	Onagraceae	Perennial	S,W_2
5. Liverwort	*Marchantia polymorpha*	Hepatophyta	Perennial	D,S,W_2
6. Creeping red woodsorrel	*Oxalis corniculata*	Oxalidaceae	Perennial (spreads by stolons)	D,S,W_2
7. Annual bluegrass	*Poa annua*	Poaceae	Winter annual	D,S,W_1,W_2
8. Birdseye pearlwort	*Sagina procumbens*	Caryophyllaceae	Perennial	S,W_1, W_2
9. Common groundsel	*Senecio vulgaris*	Asteraceae	Winter annual	S,W_1
10. Common chickweed	*Stellaria media*	Caryophyllaceae	Summer or winter annual	S,W_1,W_2

Arguably, all the weeds listed in Table 1 could be called “difficult to control.” However, I have reserved the “D” or “difficult to control” strategy to those weeds that have a particular issue with physical or chemical controls, improper herbicide selection or resistance issues. Therefore only the two bittercress, the liverwort, perennial oxalis and annual bluegrass have a “D” strategy (Table 1). Every weed in Table 1 is extremely effective at either sexual or asexual propagation. Often the “sheer numbers” strategy is a requirement of any successful weed population. “Sheer numbers” has two adaptive advantages. The first is a matter of reproductive survival, with so many propagules generated you virtually guarantee some will live to reproduce another generation. The second advantage is a matter of adaption, by reproducing in large numbers, the probability of finding that one rare individual with some selective trait for herbicide resistance, drought tolerance, handling compacted soil, or some other desired ability is significantly increased.

The ten common container weeds selected for this article (Table 1) span the gamut of life cycles. Filling different niches on the nursery production calendar in order to maximize the range of the “weed seed emergence continuum.” Container weeds emerge from early spring with the summer annuals such as chickweed, through mid-summer with the prostrate spurge, into fall with the winter annuals such as annual bluegrass and bittercress, and the perennials “somewhat ever present” depending on your region of the country with liverwort in winter or creeping oxalis in summer. The “we like it here” strategy with container weeds usually involves the appeal of the well watered and nutrient rich environment that the container provides. Some weed species such as common chickweed and pearlwort have even taken this strategy a step further to include the intersections of the container drain holes and the ground fabrics. Here these species enjoy the water-nutrient, media-laden solution that pours out the bottom

of the container after each irrigation or rain event. The “we like it here” strategy for other species, however, is all about the heat. Spotted spurge is a good example of this thriving where temperatures are “smoking hot,” it finds its niche in the container yard, in crevices of polyhouses and of course the black plastic container itself.

1. Bittercress (*Cardamine sp.*)

a) Hairy bittercress (*Cardamine hirsuta*)
b) Pennsylvania bittercress (*Cardamine pennsylvanica*)

There are many different species of bittercress; however, the two species seen most often are the Hairy bittercress (*Cardamine hirsuta*) (Fig. 1) and the Pennsylvania bittercress (*Cardamine pennsylvanica*) (Fig. 2). Hairy bittercress as an introduced species with basal leaves evenly disbursed within a rosette and is a true winter annual. As its name implies it has hairy leaves and the leaves are also rounded. Hairy bittercress is often very problematic if it becomes established in a lawn and is the species most often seen by landscapers. The Pennsylvania bittercress by contrast is a native species with erect or spreading stems, with no hair and the leaves are pointed. Although usually a winter annual the Pennsylvania bittercress can take a biennial habit. All bittercress are members of the mustard family and thus have dehiscent seed pods (Fig. 2) which is why another common name for Cardamine sp. Is Snapweed. It is this snapping property of the seed pods that makes it very “difficult” and expensive to control with hand weeding.

Fig. 1. Hairy bittercress (*Cardamine hirsuta*) note the rounded leaves. (Taken by H. Mathers)

Fig. 2. Pennsylvania bittercress (*Cardamine pennsylvanica*) note the pointed leaves. (Taken by H. Mathers)

Isoxaben (Gallery) and imazaquin (Image) are recommended for postemergence control of *Cardamine hirsuta*, although Gallery was not as phytotoxic as Image on the plants evaluated. Research demonstrated that Gallery provided excellent post emergence control of hairy bittercress with no injury to a broad spectrum of woody

ornamentals, and that control was influenced by size/age of the weed. Small non-flowering bittercress (Fig. 1) were controlled with 1.0 pound active ingredient per acre, while 2.0 pounds were necessary to control large, flowering bittercress (Fig. 2). Preemergence control is the best way to control *Cardamine sp*. Dr. James Altland, Oregon, in studies pre-dating some other the newer preemergence products such as FreeHand, Marengo and Biathlon found excellent control of Bittercress with Snapshot (Gallery + treflan). Dr. Joe Neal, North Carolina, in 2007 trials, found FreeHand (dimethamid-p + pendimethalin) was as good as or better than Snapshot in controlling bittercress. Dr. Charles Gilliam, 2011 trial, Alabama, also showed Biathlon (Goal + pendulum) at 200 lbs/ac provided excellent bittercress control. Bittercress is one of the weeds that uses all four strategies defined in this article (Table 1). It is an excellent example of a species that relishes the moist environment of a container. It is difficult to find *Cardamine sp*. Listed in traditional field weed control identification books, because it really is a marsh environment species, more native to wetlands than to agricultural or horticultural environments. However, again, the water rich environment of the container and the container drain holes makes this weed say “we like it here” and we want to stay Fig.3)!

Fig. 3. Pennsylvania bittercress (*Cardamine pennsylvanica*) taking over the container surface and thriving and in the water rich environment provided by the container. (Taken by H. Mathers).

2. Prostrate/ spotted spurge (*Chamaescyce maculata* or *C. humistrata*)

Prostrate spurge in nursery containers has been identified as one of four, of the most difficult weeds to control (Gilliam et al., 1990) and one of six, of the most dominant weed species (Penny and Neal, 2000). Mathers (1999) found that spurge was also one of the most competitive weeds. Growing in Oregon nursery containers, spurge resulted in significant growth and quality reductions in Azalea 'Rosebud' and 'Gold Cone' Common Juniper. Even though it is a “difficult” weed, I think the best strategy that prostrate/spotted spurge uses in the “weed seed continuum.” It dominates containers in mid to late summer (Penny and Neal, 2000). Optimum conditions for spurge germination include temperatures of 25-30 ºC and light (Krueger and Shaner, 1982).

Prostrate spurge germination is also influenced by fertilizer placement, methods that limit nutrient availability in the top surface of the container reduce spurge establishment (Fain and Knight, 2003). Indicating it effective use of the "we like it here" strategy. After incorporating controlled release fertilizers (CRF's), Ruter and Glaze (1992) reported 96 and 86% control *C. humistrata* 8 and 12 weeks after treatment (WAT), with combinations of the herbicides, Ronstar (oxadiazon) + Surflan AS T/O (oryzalin). Whitwell and Kalmowitz (1989), however, after topdressing CRF's found that *C. humistrata* control with combination herbicides was 59 and 52% control 8 and 12 WAT, respectively. Altland and Fain (2003) speculate that fertilizer placement may explain some of the discrepancy between results in these two studies.

In addition to the two studies listed above other researchers have found only combination herbicides provide spurge control after 30-45 DAT (Fare and Robinson, 2001; Judge and Neal, 2000). Of five herbicides that provided effective control at 28 DAT only Gallery (isoxaben) + Surflan was providing spurge control at 70 DAT (Judge and Neal, 2000). Fare and Robinson (2001) found OH2 (oxyfluorfen + pendimethalin), provided that best spurge control at 90 DAT. Judge and Neal (2000) also found that reducing Gallery from 1 lb ai/A (1X) to 0.5 lb ai /A (1/2 X), resulted in a drop from 100% to 54% in spurge control, respectively. They also found Gallery had greater activity in a sand-only media compared to a bark+sand (7:1 v/v) media. Fare and Robinson (2001) also found that containers receiving cyclic irrigation at 45 and 90 DAT versus once daily had significantly less control.

Dr. Altland (Oregon) found BroadStar (flumioxazin) and Rout (oxyfluorfen (Goal) + Oryzalin (Surflan), provided excellent to very good control, respectively. More recent studies with Dr. Gilliam (Alabama) have found the new herbicide Marengo SC or G (indaziflam) sold by OHP and Biathlon provide exceptional to good control, respectively of prostrate/ spotted spurge. In Dr. Neal's studies (2007) (North Carolina) FreeHand at 150 lb/ac provided superior spurge control versus Snapshot at 200 lb/ac or OH2 at 100 lb/ac and similar control to BroadStar at 150 lb/ac (flumioxazin).

Fig. 4. Equally at home in the sunbaked conditions of nursery container yard or the black plastic container the prostrate/ spotted spurge (*Chamaescyce maculata* or *C. humistrata*) showing its utilization of the "we like it here" strategy by thriving in these "smoking hot" conditions. (Taken by H. Mathers).

3. Marestail (*Conyza canadensis*)

Even though Marestail is a very “difficult” weed to control due to its developed resistance to glyphosate and ALS herbicides, I do not assign the difficult strategy to *Conyza.* The key reason why marestail is difficult to control does not lie in its resistance so much as in lack of understanding that this weed has two life cycles and thus needs to be controlled at two times. Many people tell me SureGuard does not work on marestail. I disagree, I believe if they timed their applications to prevent both life cycles, they would find SureGuard is quite effective.

So in keeping with the “weed seed continuum” strategy, marestail can follow a winter annual or a summer annual life cycle. Emerging in the fall and in the spring. Fall emerging marestail will have a more extensive root system than those that emerge in the spring (Johnson and Nice, 2003). The more established root system of the fall emerging plants make them more difficult to control because they can re-sprout from meristems in the lower part of the stem and roots. Therefore, systemic herbicides are required in “high enough quantities” to inhibit this re-sprouting (Johnson and Nice, 2003). Of course any use of post-emergence herbicides in containers is prohibitive and thus use of preemergence controls are preferred.

If larger older plants are present in surrounding areas or in the container yard these will have more active meristems and herbicide translocation and early control will be key factors. In fact, glyphosate products (Round up, Touchdown, Roundup Ultra, etc.) provide fairly good control of seedlings 4 inches or less in height where non-resistant populations exist. Many control failures with glyphosate products have occurred when Marestail greater than 1 foot are sprayed. Weather conditions will of course also influence the action of the systemic herbicides.

If the fall is relatively dry fewer seedlings will emerge as winter annuals. If the winter is harsh than fewer weeds will also emerge as winter annuals. This will also be true of henbit and chickweed. If the spring is dry fewer marestail seedlings will emerge as summer annuals (Johnson and Nice, 2003). Lontrel is registered for postemergence control. Preemergence registered for marestail include, Simazine, Dimension, Diuron, Gallery, Goal, Oryzalin, and Snapshot. Randy Zondag, Ohio, 2012, found excellent control of marestail with Marengo SC applied in fall at 14.5 fl oz/ac that carried through into June, 2013. Marengo seems to be a promising product for those having difficulty with control.

Fig. 5. Marestail (*Conyza canadensis*) can produce over 200,000 seeds/ plant with pappus that allow the seed to fly over a mile. This combined with its two life cycles makes it the best example of using the "sheer numbers" strategy. (Taken by H. Mathers).

4. Northern Willowherb (NWH) (*Epilobium ciliatum)*

As a member of the primrose family Northern willowherb (NWH) is easily recognized by it four alternating sepals and petals when viewed from the top (Fig. 6). NWH is also characterized by erect stems that can be one to six feet tall (Fig. 7), in a loose clump from a basal rosette of leaves. The leaves are also lance-shaped, toothed and conspicuously deeply veined with short petioles (Fig. 8). Foliage and stems are green to purple (Fig. 8). A perennial native to moist meadows, stream-banks and roadsides, NWH is another good example of the "we like it here" strategy. NWH takes full advantage of the container environment of luxury water and feeding. It quickly establishes, taking only 8 weeks to produce a mature perennial plant from seed. NWH will flower all spring and summer maximizing on its "sheer numbers" strategy. NWH, however, is a widely variable species with several similar subspecies such as *E. watsonii,* subsp. *Glandulosum.* Capsule number, number of seeds in a capsule and percent viability of seed within the capsule are also highly variable. The variability is mainly controlled by nutrient loading. In high fertility, a large NWH plant will grow and produce approximately 200 seed capsules/plant with 81 seed/capsule and 65% seed viable or 10,410 viable seed. In a low fertility environment, however, as few as 400 viable seed from each plant may be produced. Each seed can germinate within two to four days after falling from the capsule regardless of fertility levels.

Fig. 6. Northern willowherb (NWH) (*Epilobium ciliatum)* typical primrose family flower. (Taken by H. Mathers).

Fig. 7. Northern willowherb (NWH) (*Epilobium ciliatum)* erect stems that can reach one to six feet in height. (Taken by H. Mathers).

Fig. 8. Northern willowherb (NWH) (*Epilobium ciliatum)* leaves from a loose rosette at the base and are lance-shaped, toothed, and conspicuously deeply veined with short petioles. Foliage and stems are green to purple. (Taken by H. Mathers).

The best control of NWH was found to be with granular Ronstar at 200 lb/ac (Cramer and Altland, 2005). Sprayed preemergence herbicides with Gallery alone or tank mixed provided little to no control of NWH (Cramer and Altland, 2005).

5. Liverwort (*Marchantia polymorpha)*

Marchantia polymorpha L. (a thalloid liverwort) is a common plant pest in nursery and greenhouse production systems. The presence of liverwort is considered unsightly and is often taken as an indication of reduced quality or plant vigor, all of which impacts the final valuation of the crop (Fig. 9). The rapid growth and dissemination of liverwort has resulted in heavy thallus mats on the surface of pots, restricting water penetration, competing for nutrients, and providing habitat for other pests and disease vectors. To date *there are no registered products* that are used by nursery growers for effective liverwort control in enclosed structures. What is reported below are Ohio State University, research trials, not registered products. We have evaluated SureGuard at ¼ the normal rate in an attempt to reduce phytotoxicity but maintain liverwort control. We have also examined Baking Soda and MilStop® (Potassium Bicarbonate 85%, BioWorks®, Victor, NY).

Fig. 9. Severe liverwort infestations creating a thick thallus mat on the container surface will reduce water and nutrient movement to the plant and causes significant growth and plant quality reductions. (Taken by H. Mathers).

We have identified SureGuard at 3 oz./ac (1/4 normal rate); WeedPharm™ (20% acetic acid) at 10% v/v (Pharm Solutions Inc., Port Townsend, WA), MilStop® (5 g/ ft^2) and Baking soda applied as a dusting (2.24 g/ ft^2) can all be effective in controlling liverwort. However, WeedPharm will cause phytotoxicity as will SureGuard if not applied dormant. MilStop® is an OMRI listed sprayed broad spectrum fungicide (with **no** registration as an herbicide). Used as a spray MilStop® was non-effective for liverwort control. Baking soda is not registered for moss control. However, applications made with a handheld crop duster were very efficacious with no phytotoxicity noted. The

duster used in these trials is similar to a Dustin Mizer (Nitron Industries). Further work with rates of MilStop® and Baking Soda are warranted.

Liverwort control. All treatments with the exception of the MilStop® applied as a liquid provided some level of liverwort control (Table 2). MilStop® is marketed as a fungicide when applied as a liquid at the tested rates, and in this trial, it was not an effective treatment to control liverwort. On the contrary, when MilStop® is applied without water, right out of the bag, it controlled liverwort very well (Table 2). MilStop® in its granule form has an inhalation hazard and is NOT labeled to be applied in this form. WeedPharm™ will control liverwort; both at 5% and 10%, with the 10% solution having better control, but in most cases the two are not significantly different from each other. From our trial, the 5% solution would be a better choice, especially in terms of economics. However, with WeedPharm™, just like many other "contact" control herbicides, thorough coverage is necessary. Whenever the liverwort was covered by plant foliage, control decreased. WeedPharm™ also seems to work better under higher temperatures (Table 2). Although baking soda does not have a label for weed control, a few nurseries use it for liverwort control, and thus we added to the trial.

Baking soda provides exceptionally liverwort control (Fig. 4B), although residual is limited. SureGuard has shown to control liverwort in previous studies. The IR-4 protocol suggested using a rate of 4 oz/ac; a rate. The 3 oz/ac was added in our Ohio State University trial. In terms of control, the two rates were *not* significantly different from each other at any evaluation (Table 2). SureGuard is slow to control liverwort but is the only product we have tested that provides residual control for liverwort (Table 2).

Phytotoxicity. Phytotoxicity was evaluated using hydrangea (*Hydrangea* 'Invincibelle spirit'), winterberry (*Ilex verticillata* 'Winter red'), dwarf burning bush (*Euonymus alata* 'Unforgettable fire'), lilac (*Syringa patula* 'Miss Kim') viburnum (*Viburnum rhytidophyllum* 'Cree'), hosta (*Hosta* 'Halcyon'), Autumn fern (*Dryopteris erythrosora*), liriope (*Liriope spicata*), Russian sage (*Perovskia atriplicifolia)*, and Dwarf Korean lilac (*Syringa meyeri* 'Palibin') (Table 2). SureGuard applied dormant caused little injury; however, the damage that SureGuard provided at both rates after the second application is quite noticeable in many of the species tested. This provides evidence that SureGuard may be applied as a dormant application on many species that are normally injured by SureGuard when applied during the growing period. Even after the second application, SureGuard did not injure *Viburnum* or *Dryopteris* at the 3 or 4 oz. rate. When applied as a liquid, MilStop® provided no real damage on any of the species tested. MilStop® did cause damage to 6 of the 10 species tested when applied as a granular. Baking Soda was phytotoxic on active growth with 8 of 10 species. WeedPharm caused significant damage, with the higher rate causing more damage than the lower rate. *Dryopteris* and *Viburnum* were the only species not significantly damaged by WeedPharm™. WeedPharm™ is acetic acid, which causes leaf burning, but eventually many plants will grow out of the damage if not too severe. Our trial also provided evidence that liverwort infestations do cause growth reduction due to the thick thallus mat and thus control is important.

Table 2. Liverwort control from various products at Nursery 1 and Nursery 2.

Nursery 1

Treatment	Rate	1 WAT[z]	2 WAT	4 WAT	1 WA2T	2 WA2T	4 WA2T
Baking Soda	10 g/ft^2	9.6[yx] a	9.6 ab	9.8 a	10.0 a	10.0 a	10.0 a
MilStop	2.5 lbs./100 gal	4.0 c	4.1 c	4.8 c	4.6 b	5.1 b	4.5 b
SureGuard	3 oz./ac	6.7 b	8.5 b	10.0 a	10.0 a	10.0 a	10.0 a
SureGuard	4 oz./ac	6.3 b	8.6 b	9.9 a	10.0 a	10.0 a	10.0 a
WeedPharm	5%	9.0 a	8.8 b	7.9 b	9.2 a	9.3 a	9.1 a
WeedPharm	10%	9.7 a	9.8 a	9.3 a	10.0 a	9.9 a	9.7 a
MilStop	2.5 tbsp./flat	9.8 a	9.9 a	9.3 a	9.9 a	10.0 a	9.6 a
Untreated	--	3.5 c	3.2 c	3.9 d	4.5 b	4.6 b	4.6 b

Nursery 2

Treatment	Rate	1 WAT	2 WAT	4 WAT	1 WA2T	2 WA2T	4 WA2T
SureGuard	3 oz./ac	5.3 cd	5.9 b	7.2 b	8.2 a	8.4 a	9.1 a
WeedPharm	5% v/v	6.8 bc	6.6 b	7.9 b	9.2 a	9.0 a	8.8 a
MilStop	5 g/ft^2	9.8 a	9.8 a	9.5 a	9.1 a	9.5 a	9.6 a
Baking Soda	2.2 g/ft^2	8.0 ab	8.5 a	7.9 b	5.2 b	5.1 b	--
Untreated	--	3.7 d	3.5 c	3.2 c	2.0 c	2.1 c	1.5 b

z = WAT: weeks after first treatment; WA2T: weeks after second treatment

y = Liverwort control ratings based on a 0-10 scale with 0 being no control and 10 perfect control with ≥7 commercially acceptable

Conclusions

As we discussed in the introduction, the weed species that have invaded your containers and container yards, have done all their planning and are successfully utilizing their four strategies for "fun" – **DSWW.** In the second part of this article we will continue with creeping oxalis, annual bluegrass, pearlwort, common groundsel, and common chickweed to see how they are utilizing the "**D**ifficult to Control", "**S**heer Numbers" "***W****eed Seed Continuum*" and/or a "***W****e like It Here*" strategy for a happy, prosperous life at nursery near you!