

The Glyphosate, Weeds, and Crops Series

Biology and Management of Wild Buckwheat

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Biology and Management of Wild Buckwheat

Heavy reliance on glyphosate — whether applied as a burndown before planting; used in-crop on Roundup Ready® soybeans, corn, alfalfa, cotton, and canola; or as a harvest aid — has resulted in serious concerns for the long-term viability of this valuable weed management tool. Large differences in biotype susceptibility to glyphosate was reported in Indiana during the mid-1980s in field bindweed (DeGennaro and Weller, 1984). But weed resistance to glyphosate became a widespread concern after Roundup Ready® crops had been available to growers for several years.

Glyphosate-resistant horseweed biotypes have been reported throughout the East, Midwest, and Canada's Prairie Provinces. In addition to weeds that develop resistance, there is a concern that weed populations could shift toward species naturally tolerant of glyphosate due to selection pressure from one herbicide and one mode of action. Weed species that have become greater problems because of the dominant use of glyphosate include kochia, nightshade species, common lambsquarters, waterhemp, smartweed, horseweed, prickly lettuce, common mallow, velvetleaf, dandelion, and nutsedge (Zollinger, 2005). These species may require growers to use herbicides with different modes of action, use higher glyphosate rates, or make sequential glyphosate applications for adequate control.

Wild buckwheat has become a serious problem in the Plains and Upper Great Plains. Although herbicide resistance has not been documented for wild buckwheat, high populations of this weed species endemic throughout the region and the weed's natural tolerance to glyphosate may increase its prevalence in locations of high glyphosate use (Heap, 2005).

The purpose of this publication is two-fold. First, it will describe the biology of wild buckwheat, showing why this weed is particularly troublesome in agronomic crops. Second, it will provide management strategies to help growers increase wild buckwheat control.



Figure 1. Wheat infested with wild buckwheat.

Identification

Wild buckwheat is a summer annual that grows from a hard, black, triangular seed about 1/8 inch long (see Figure 2). The cotyledons are narrow with a rounded tip and base. The plant has long, slender, creeping stems that trail along the ground or climb any plants or objects they contact (see Figure 1). The leaves are alternate, heart- or arrowhead-shaped, pointed at the tip, and have widely separated lobes at the base (see Figure 3). Plants bloom throughout the summer and the flowers are small and have no petals, but have five greenish or pinkish sepals. Flowers are located in short-stemmed clusters in the axils of the leaves or at the end of stems (see Figure 4).

Wild buckwheat is a member of the smartweed family. Like other smartweeds, wild buckwheat possesses an ocrea (thin membrane) around the stem at each node (See Figure 5). It can be confused with field bindweed because of its vining growth habit and arrowhead-shaped leaves. Field bindweed, however, is a perennial, has an extensive underground root system, does not possess an ocrea, and has large funnel-shaped flowers that are white or pink. Also, wild buckwheat's lower leaves are usually much wider than bindweed leaves.



Figure 2. Wild buckwheat grows from hard, black, triangular seeds about 1/8 inch long.



Figure 3. Note the narrow cotyledons and rounded base on this wild buckwheat seedling. The weed's leaves are alternate, heart- or arrowhead-shaped, and pointed at the tips.



Figure 4. Wild buckwheat produces flowers in short-stemmed clusters in the axils of the leaves or at the end of stems. Flowers are small and have no petals, but have five greenish or pinkish sepals.



Figure 5. A distinguishing characteristic of wild buckwheat is that it has an ocrea, or thin membrane, around the stem at each node — a characteristic it shares with other smartweeds.

Distribution and Emergence

Wild buckwheat is native to Europe and has become widely distributed in temperate regions via grain transport. Wild buckwheat also is one of the most common contaminants in all seed stock. Its seed is similar in diameter to wheat seed and is often planted with the grain (see Figure 6). At harvest, many seeds do not thresh completely from the seed coat and are especially difficult to clean from wheat. Wild buckwheat grows



Figure 6. Wild buckwheat seeds are one of the most common contaminants in all seed stock. This photo shows black, triangular wild buckwheat seeds mixed with wheat seeds. The two seeds are similar in diameter.

everywhere crops are cultivated in Europe and North America and is common in more than 40 other countries. It has become an important agronomic weed throughout the Plains, Northern Plains, and Canada's Prairie Provinces (Forsberg and Best, 1964). It also has become troublesome in some Midwest states such as Iowa.

A single wild buckwheat plant can produce 12,000 seeds over the course of a single growing season, although only 3 percent of the seeds germinate after reaching physiological maturity and shedding from the plant. The other 97 percent remain dormant and can germinate if they are exposed to temperatures ranging from 37°F to 41°F for eight weeks. About 75 percent of all seeds are initially viable, and seeds can remain viable in the soil for five years (Chepil, 1946; Wertz, 1986).

Wild buckwheat begins germinating very early in the spring during the first prolonged warm period, beginning as early as March in Kansas and April in North Dakota. The majority of wild buckwheat seed emergence occurs by mid-June. The majority of germination takes place in the top 2 inches (5 centimeters) of soil, but emergence has been observed from as deep as eight inches. After that, intermittent seed germination occurs throughout the growing period until September (Stevens, 1947; Vanden Born and Corns, 1958).

Growth and Development

Wild buckwheat's climbing habit allows the plant to obtain sunlight while growing in stands of grain or other tall crops. It also can spread horizontally and quickly cover bare ground, enabling it to maximize light-gathering efficiency.

Growth studies in Saskatchewan demonstrated that wild buckwheat seed planted between April 15 and July 15 took an average of 17 days to emergence, 28 days to first and second true leaf, 31 days to third true leaf, 50 days to first vine, and 61 days to first flower. (Forsberg and Best, 1964). Stem growth increases as temperature increases, but growth is slowed under hot, dry conditions and when plants enter the reproductive phase. Flowering is indeterminate and all stages, from new buds to ripe seeds, can be found on one plant. Flowering may begin in late June in warmer regions.

Interference and Competition

Wild buckwheat infests much of the area where small grains are grown. In northeast South Dakota, Doseland and Arnold (1964) found wild buckwheat in 93 percent of the fields surveyed, with an average infestation of about 40 plants per square meter.

Research on wild buckwheat competition with row crops is limited, but research shows that competition commonly causes yield losses in small grains. Competition studies in wheat show that wild buckwheat is more competitive than green foxtail but less competitive than kochia, wild mustard, wild oat, and sunflower (Friesen and Shebeski, 1960). Yield loss in wheat was approximately 4 percent where there were 50 wild

buckwheat plants per square meter, up to about 12 percent where there were 200 wild buckwheat plants per square meter. However, yield losses may range from 15 to 66 percent depending on wild buckwheat density, environment, and type of crop (Forsberg and Best, 1964).

In addition to competing for nutrients, light, and moisture, wild buckwheat causes difficulty in harvesting crops. Its vines tangle around the moving parts of swathers and combines, often causing mechanical failures. In stored grain, large amounts of wild buckwheat seed can cause spoilage because the weed seed's moisture content raises the temperature in the grain bin high enough to deteriorate the grain and allow fungi to grow. Furthermore, wild buckwheat is a host for several crop plant diseases, including virus yellows of beets and cucumber, alfalfa mosaic virus, and tobacco rattle virus.

Increased Prevalence

Three factors are commonly mentioned as the causes of increased wild buckwheat prevalence: plant biology, inadequate control from cultural practices, and tolerance to many small grain and row crop herbicides, including glyphosate.

Plant Biology

Wild buckwheat is persistent, tenacious, resilient, and relentless despite many effective control strategies. A North Dakota weed survey conducted in 1978 and 1979 showed wild buckwheat to be the third most abundant weed in the state (Dexter et al., 1981). Twenty-two years later, a similar survey found that wild buckwheat was still the third most abundant weed (Zollinger et al., 2003). Between 1978 and 2000 there were many advances in chemical and weed control technology, resulting in many new herbicides and herbicide modes of action. Despite these additional control tools, the relative level of wild buckwheat infestation was not diminished.

In another survey conducted after herbicides were applied in 2000, the relative abundance of wild buckwheat was ranked fifth among all weeds found. The frequency of wild buckwheat in North Dakota was 56 percent (in 1978), 65 percent (1979), 46 percent (spring 2000), and 32 percent (summer 2000), and at densities of seven (1978), four (1979), 13 (spring 2000), and 10 (summer 2000) plants per square meter. So while wild buckwheat occurred half as frequently in 2000 as it did in 1979, it occurred at twice the density in 2000. These greater densities may be due largely to increases in no-till acreage, row crop acreage, and greater than average precipitation in the 1990s. Similar results were found in Alberta, Saskatchewan, and Manitoba where wild buckwheat was one of the three most prevalent weeds, occurring in 53 percent of the fields at a density of four plants per square meter from 2001 to 2003 (Leeson et al., 2005).

Cultural Practices

Cultural practices, such as crop rotation, mowing, delayed seeding, post-seeding harrowing, or post-harvest cultivating, can reduce wild buckwheat stands, but have not been effective in control. This is because seedling emergence is not restricted to any specific period, so seedlings can emerge throughout the growing season. Nevertheless,

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wild buckwheat often infests the semi-arid region of the United States, where weed control efforts rely more on herbicides than tillage. These locations use reduced tillage or no-till production practices to conserve soil moisture and prevent soil erosion. Delayed crop seeding can provide some wild buckwheat control by killing early germinating seedlings through seedbed preparation or burndown herbicide applications. However, late seeding some crops, such as small grains and flax, is not recommended because of lower yield potential.

An acre of wheat heavily infested with wild buckwheat can produce more than three bushels of wild buckwheat seeds. There are approximately 85,000 wild buckwheat seeds per pound, which would yield more than 10 million seeds per acre. One of the most effective ways to control wild buckwheat is to plant clean crop seed. Planting crop seed contaminated with just 1 percent of wild buckwheat seed by weight would add 27 wild buckwheat seeds per square meter in the field. The extra cost of certified seed may be easily recovered by savings in weed control (Greer et al.).

Herbicide Tolerance

Small Grains

For several decades, wild buckwheat quickly became a problem in small grains because of its tolerance to both 2,4-D and MCPA used at normal field rates. These herbicides would kill other competitive weeds (for example, wild mustard), increasing wild buckwheat infestations and competitive ability. MCPA will not control wild buckwheat at any field use rate. High 2,4-D rates may control buckwheat but are not normally used because of crop injury risk.

Soybeans

In soybeans, applications of soil or post-applied herbicides often result in incomplete wild buckwheat control. Some of these herbicides include dintroaniline (Treflan[®], Sonalan[®], Prowl[®]), chloracetamide (Dual[®], Intro[®], Outlook[®]), PPO inhibitors (Ultra Blazer[®], Flexstar[®], Cobra[®]), bentazon (Basagran[®]), and clomazone (Command[®]). A lack of effective herbicides for wild buckwheat control in conventional soybeans has been a problem for several years.

Roundup Ready[®] Crops

With the rapid adoption of Roundup Ready[®] crops in North America, there is tremendous selection pressure on weed populations from one herbicide: glyphosate. As a result, weeds less sensitive to glyphosate (including wild buckwheat) may replace those that typically infested conventional systems.

Control of wild buckwheat with glyphosate depends on application rate, plant size, environment, and water quality. Early wild buckwheat germination, limited use of soil-applied foundation herbicide treatments, the tendency of growers to delay postemergence applications until most weeds have emerged, and growers making only one glyphosate application to large wild buckwheat plants are all factors that often result in inadequate control. Growers who apply reduced glyphosate rates to small wild buckwheat plants may kill some and temporarily suppress the growth of others. Applying the recommended glyphosate rate of

0.75 lb. ae/A (1 quart of 3 lbs. ae/gallon or 22 fl. oz. of 4.5 lbs. ae/gallon formulation) may result in poor control of small plants and will not control large wild buckwheat plants (Table 1). Wild buckwheat growing in adverse conditions makes control even more difficult.

Fortunately, resistant wild buckwheat biotypes have not been documented to any previously or currently used herbicide chemistries, including glyphosate.

Table 1. Wild Buckwheat Control with Glyphosate Alone or Tank-mixed with Additional Herbicides

Wild buckwheat height	glyphosate alone 0.75 lb. ae/A	glyphosate @ 0.75 lb. ae/A +							glyphosate required for 90% control (lbs. ae/A)
		Classic® 0.3 oz./A	Flexstar® 8 fl. oz./A	Phoenix® 5 fl. oz./A	Raptor® 3 fl. oz./A	Scepter® 1.44 oz./A	Ultra Blazer® 2 fl. oz./A	Extreme® 48 fl. oz./A	
Percentage of Wild Buckwheat Control									
3 inches tall	70	83	87	93	83	87	88	100	1
6 inches tall, 12 inch runners	60	53	78	90	70	75	86	63	1.16
6 inches tall, 24 inch runners	45	50	73	67	68	68	75	57	1.4

Source: Stevan Knezevic, University of Nebraska Haskell Agricultural Laboratory, Concord, Nebraska.

Control

Glyphosate

Wild buckwheat and related smartweed species have some natural tolerance to glyphosate. Wild buckwheat control from glyphosate is reduced when applications are made at lower than labeled rates, when only one glyphosate application is made, when plants are stressed from adverse environmental conditions, or when runners are more than 3 to 4 inches long. Glyphosate has no soil residual activity to control later weed flushes throughout the growing season.

Other Effective Herbicides

The most effective herbicides on wild buckwheat are atrazine, bromoxynil, clopyralid, dicamba, glufosinate, and some sulfonylurea products. Using these herbicides or mixtures with these ingredients will ensure the most effective wild buckwheat control. Atrazine, clopyralid, dicamba, and some sulfonylurea herbicides may persist in the soil and carry over for more than one growing season, especially in soils with high pH. The long residual sulfonylurea herbicides effective on wild buckwheat are chlorsulfuron (Finesse®, Glean®) and triasulfuron (Amber®).

Thifensulfuron (Harmony GT XP®) is a short residual sulfonylurea herbicide effective on wild buckwheat. The thifensulfuron rate labeled in small grains is 3/10 to 6/10 ounce of product per acre compared to only 1/12 ounce of product per acre in soybeans. Consequently, the rate allowed in soybeans may be too low to achieve adequate wild buckwheat control. Stacked trait Roundup Ready® and Sulfonylurea Tolerant Soybean® (STS®) varieties allow for higher thifensulfuron rates to control wild buckwheat. Tank-mix applications of glyphosate plus thifensulfuron in Roundup Ready®/STS® soybeans will control wild buckwheat and many other grass and broadleaf weeds.

Preplant Burndown in No-Till

Wild buckwheat has become a major weed problem in no-till fields prior to spring planting. All existing weeds (including wild buckwheat) should be controlled prior to planting or emergence of no-till crops with a preplant burndown herbicide treatment. Glyphosate or glyphosate plus 2,4-D is often inadequate for wild buckwheat control. Adding or using another herbicide may be necessary to achieve adequate wild buckwheat control, but proper waiting intervals between applications must be observed. Crops planted before early or mid-May could require an in-crop herbicide application to control late emerging plants. This strategy will allow earlier postemergence applications to smaller plants.

Several herbicides can be used to control wild buckwheat and are listed in Table 2. Commercial premixes that contain the active ingredients listed in Table 2 also can be used.

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Table 2. Wild Buckwheat Control

Herbicide	Rate (product/A)	Small Grains	Corn	Soybeans
Aim®	0.5 fl. oz.	S	S	
Ally®	1/10 oz.	C		
Ally Extra®	2/10-4//10 oz.	C		
Amber®	0.28-0.56 oz.	C		
atrazine + premixes	0.38-0.5 lb. ai		C	
bromoxynil	1-2 pts.	C	C	
clopyralid (Stinger®)	0.25-0.67 pts.	C	C	
Callisto®	3/8-3/4 oz.	S/C		
Curtail®	2-2.67 pts.	C		
Curtail M®	1.75-2.33 pts.	C		
dicamba + premixes	2-4 fl. oz.	C	C	
Distinct®	4-6 oz.		C	
Extreme®	2.25-3 pts.			S/C
Finesse®	2/10-4/10 oz.	C		
Glean®	1/6-1/3 oz.	C		
glyphosate	0.75-1.75 lbs. ai	S/C	S/C	S/C
Harmony Extra®	3/10-6/10 oz.	S/C		
Harmony GT®	3/10-6/10 oz.	C		
Harmony GT®	1/12 oz.			S
Hornet® (PPI/PRE)	4-6 oz.		C	
Liberty® (Liberty Link®)	28-34 fl. oz.		C	
Lightning® (Clearfield®)	1.28 oz.		C	
Peak®	3 oz.		S	
Pursuit Plus®	1.8 pts.			C
Spartan®	3-8 fl. oz.			S
Valor®	2-3 oz.			S
Widematch®	1-1.33 pts.	C		

C = Control

S = Suppression

Empty boxes = not known

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