

APPLE OF PERU BIOLOGY AND CONTROL IN CORN, SOYBEAN, AND VEGETABLE CROPS. Joel Felix and Douglas J. Doohan, Postdoctoral Research Associate and Associate Professor, Department of Horticulture and Crop Science, The Ohio State University/Ohio Agricultural Research and Development Center, Wooster, OH 44691.

Field, laboratory, and greenhouse research was conducted at the Ohio Agricultural Research and Development Center, Wooster, OH in 2003 and 2004 to study the biology and control of apple of Peru (*Nicandra physalodes* L.) in soybean, corn, and vegetable crops. Apple of Peru is a monotypic, solanaceae summer annual with erect glabrous or sparsely pubescent stems growing up to 2 m tall and reproducing only by seeds. It is also known as *shoofly*, purportedly due to its ability to repel insects. Leaves are broadly ovate, 4-20 cm long and 2-15 cm wide with irregularly toothed margins. The lower leaf surface is glabrous, while the upper surface has pronounced sparse, short, inflated, glandular hairs whose color varies depending on plant pigmentation. Apple of Peru germinates continuously (spring through fall) in agricultural fields if moisture is available. It is an indeterminate plant, with flowering commencing 14 to 25 days after emergence depending on day length. Flowering terminates the apical dominance of the main stem, resulting in branching to form a dense canopy. Apple of Peru has attractive trumpet-shaped purple/lavender flowers that may occasionally be white. Fruits are borne singly in a bladder-like structure encasing a single berry resembling those of their distant cousins, the groundcherries. Unlike groundcherries, however, the berry casing of apple of Peru will rupture on contact at maturity, shattering the seeds. Mature seeds are innately dormant, requiring chemical treatment to alleviate dormancy.

Apple of Peru is a recent invader of fields in north central Ohio. We first identified this weed in several vegetable fields in Seneca and Sandusky Counties in August 2002. In most fields, the distribution was scattered; however, in one 12 ha field, it was found in each of 30 randomly placed quadrats. Apple of Peru has been recorded in Ohio since at least the late 1890's, but was never before observed in farmed land. The weed is conspicuously absent from contemporary weed guides, suggesting it has not been an item of research in the United States.

Laboratory tests to determine seed dormancy were conducted in seed germination chambers, with studies arranged in completely randomized design. Four chemicals were tested for their ability to relieve dormancy: sodium hypochlorite (household bleach), concentrated sulfuric acid (H_2SO_4), 0.2% potassium nitrate (KNO_3) solution as a wetting agent, and gibberellic acid (GA_3). Newly harvested seeds were counted and placed on blue germination paper in a petridish (100 seeds each) wetted either with water, 0.2% KNO_3 solution, or 0.0001 M gibberellic acid (GA_3). Each replication was placed in a zip lock bag to minimize moisture loss and placed in a germination chamber set at 30/25°C for 12/12hr and 8/16hr of light/dark, respectively. Untreated seeds wetted only with water did not germinate, whereas seeds previously soaked in sodium hypochlorite for 2 minutes resulted in 98% germination, with water as a wetting agent. Seeds previously immersed in concentrated sulfuric acid for 2 minutes had 25-45% germination. Using 0.2% KNO_3 as a wetting solution following treatment with sodium hypochlorite resulted in 25-40% germination, and only 25% germination when seeds were emersed in 0.0001M GA_3 for 24 hrs.

Field study results indicated apple of Peru to be a prolific seed producer, capable of producing between 200,000 and 1,200,200 seeds per plant depending on size and growing conditions. Field count data indicated germination of only about 2% of the seeds produced in the preceding season. This suggests the potential for a rapid buildup of a persistent seedbank in the soil. To determine the ability of apple of Peru seeds to germinate from different depths, seeds were placed at 0, 0.6, 1.3, 2.5, 5.0 and 10.0 cm in pots filled with a three-way mix of mineral soil/perlite/peat and placed in a greenhouse room set at 28/15°C (day/night) and a photoperiod of 16/8hrs. Pots were kept moist using a daily fine water mist. Total emergence after 30 days was 60, 77, 80, 60, and 15% for respective seeding depths.

It took longer for seeds placed on the surface to germinate, a fact that may explain why we have not spotted the weed in no-till fields.

A 2-year field study involving apple of Peru at an average density of 3585 seeds ha¹ timed to germinate at the same time with drilled soybeans resulted in a soybean yield reduction of 568 kg/ha.

Even though greenhouse tests had originally suggested differential tolerance to glyphosate, a field study in 2004 indicated effective control of apple of Peru in glyphosate-tolerant soybeans. Apple of Peru has exhibited sensitivity to triazines, PPO inhibitors, and Mesotrione. But ALS inhibitors such as Imazethapyr, and Rimsulfuron as well as chloroacetamides such as *s*-Metolachlor, Alachlor, and Dimethenamid, exhibit poor to moderate control. The weed is also tolerant of bleaching herbicides such as clomazone. Poor control from Clomazone and *s*-Metolachlor is especially troubling considering their utility in major vegetable production operations.

Initial findings suggest a serious threat if the current apple of Peru infestation is left unchecked, due to many factors. Apple of Peru has shown tolerance to many commonly used herbicides, and it is very competitive with crops. The ability of apple of Peru to produce dormant seeds in large quantities suggests a potential to build up a long lasting seedbank.