WEED AND CROP MIMICRY

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Weed Science Society of America has been defined weed as any plant that is objectionable or interferes with the activities or welfare of human [1]. Further, they are recognized as unwanted economic pest in agriculture fields. Because of this, when famers grow crops intentionally and manage them to obtain useful material, weeds come out associating the crops without human influence and they compete with crops for the limited resources such as light, water, nutrient and space in the field [2]. It causes to reduce the crop yield and increase the labor, machinery and herbicide cost. For example, USA famers annually spend $6 billion for herbicides and tillage to control weeds [3].

Although, weeds are considered as natural enemies in the agriculture field, there are some useful benefits provided by them in spite of their negative impacts (Table 1).

Table 1: Direct negative impacts and benefits of weeds in the agricultural field.

Negative Impact	Benefit
Reduce crop quality by contamination	Soil stabilization
Reduce crop yield	Habitat and feed for wildlife
Serve as hosts for crop diseases	Nectar for bees
Provide shelter for pest	Aesthetic qualities
Limit the choice of crop rotation sequences	Add organic matter
Production of allelopathic substances for crops	Provide genetic reservoir
Production of toxic substances for animals or humans	Human consumption

Early weeds were naturally pioneer plants of secondary successions. As a result of ability to tolerate a range of biotic and abiotic constraints and ability to adapt quickly to a new habitat, they have the natural potential to become agricultural weed. The success of weeds depends on their broad environmental tolerance and phenotypic plasticity. However, weed species show one or more different and specific characters that have equipped them to compete with crops (Table 2).

Crop mimicry

Some weed species are specialized to a particular crop by resembling the crop morphologically, phonologically, or biochemically in the same habitat [4]. This phenomenon is known as crop mimicry of weeds. In this case, resemblance may have occurred due to the gene exchange from crop to weed [4]. Since some crop-weed associations are so intimate, controlling weeds without causing damage to the crop is very difficult. Morphological mimicry may be vegetative mimicry or/and seed mimicry. In vegetative mimicry, appearance of seedling and vegetative growth of weed plant simulates that of the associated crop (Figure 1). This is a good adaptation for the survival of the weed during manual weed controlling. In seed mimicry, weed produce seeds

which are similar to crop seeds in appearance, weight or/ and density. Most of the time, phonological mimicry (seed distribution happen in similar time) combines with the seed mimicry. On that reason, seed mimicry facilitates weed seeds to distribute secretly with their associate crop seeds. Since removal of mimic seeds using machineries or herbicide is very difficult, seed mimicry is more important than vegetative mimicry on survival the weed species.

Table 2. Specific characters of weeds that useful to invade in crop field [1]

Germination requirements fulfilled in many environments
Discontinuous germination
Abundant seed production
Continuous seed production
Great longevity of seeds
Tolerance of seed in a wide range of environmental conditions
Seed dormancy (to germinate in favorable condition)
Very high seed output in favorable environmental circumstances
Adaptations for short-distance dispersal and long-distance dispersal
Rapid growth through vegetative phase to flowering
Cross-pollination by unspecialized visitors or wind
If perennial, vigorous vegetative reproduction or regeneration from fragments
Ability to complete interspecifically by special means (rosettes, choking growth, allelochemicals)

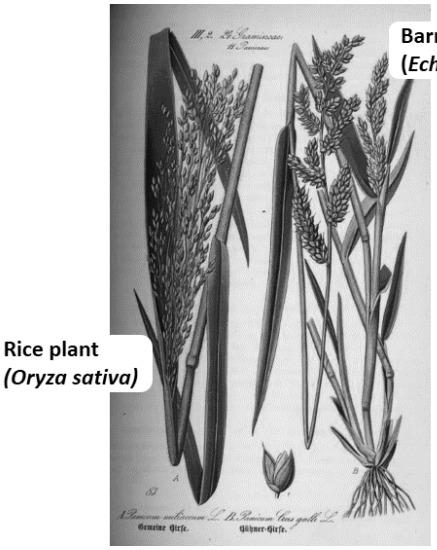

Figure 1: Barnyard grass (Echinochloa crus-galli) is a one of mimic weed in the paddy field in south Asian countries. This plant is very similar to rice plant in morphologically (color, shape and height). Both rice plant and Barnyard grass produce seed in similar period of time. Currently they are becoming resistant to the herbicide.
(http://luirig.altervista.org/cpm/albums/thome/thome00144-echinochloa-crus-galli.jpg)

Herbicide resistance in weeds forms as a result of biochemical mimicry of weeds. According to the International Survey of Herbicide Resistant Weeds, there are 245 species with resistant to herbicides and herbicide resistant

weeds have been reported in 86 crops in 66 countries [5]. Reference [6] has stated that there are 116 weed species with resistant to the acetolactate synthase (ALS) and 21 species are resistant to gluphosate.

Although, animal mimicry has been well documented, plant mimicry has received less attention. Further, virtually experimental studies are deficient on this type of coevolutionary phenomenon in weeds, while most reports in the literature have merely document the form of resemblance between crops and weeds [4].

Weed communities in crop fields frequently differ in species diversity due to adaptive strategies of weed population diversified by agricultural practices [4]. Therefore, increase of use of herbicide and development of sophisticated seed cleaning machinery will be replaced current mimicry with another specialized agroecotypes of weeds in the next genera.

Reference

1. Weed Science Society of America. (1956). Terminology Committee Report-WSSA. *Weeds*. 4:278–287.
2. Liebman, M. (2001). Weed management: a need for ecological. *Ecological management of agricultural weeds*, 1.
3. Chandler, J.M. (1991). Estimated losses of crops to weeds. In CRC *Handbook of Pest Management in Agriculture*, vol. 1, ed.D. Pimentel, pp. 53–65. Boca Raton, FL: CRC Press.
4. Barrett, S. H. (1983). Crop mimicry in weeds. *Economic Botany*, *37*(3), 255-282.
5. International Survey of Herbicide Resistant Weeds (2015). *http://www.weedscience.org/summary/home.aspx* (accessed on March 11, 2015).
6. Vencill, W. K., Nichols, R. L., Webster, T. M., Soteres, J. K., Mallory-Smith, C., Burgos, N. R., ... & McClelland, M. R. (2012). Herbicide resistance: toward an understanding of resistance development and the impact of herbicide-resistant crops. *Weed Science*, *60* (sp1), 2-30.