Recalcitrant invasives, herbicide resistant weeds, and biodiversity – Non-ceremonial relationships?

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Abstract Modern agriculture in many respects can be equated with parallel introduction, and ensuing emergence of recalcitrant invasives, including herbicide resistant weeds at increasing monumental scale. With intensive agricultural pursuits and activities, embedded usually with heavy usage of synthetic fertilizers and agrochemicals principally pesticides, the inevitable consequence of successive emergence of recalcitrant millennial weeds and herbicide resistant weed species, and the possible negation on biodiversity are also the tell-tales of modern agriculture. The issue of such invasions has ramifications throughout modern economies involving global trade, agriculture, and genetic engineering on one end of the continuum, and biodiversity, environmental health, water management, and climate change on another. With these anthropogenic components coupled with ensuing globalization comes 'globalization' of recalcitrant invasives. The pertinent question of the non-ceremonial relationships or possible 'trade-offs' between recalcitrant invasives including herbicide resistant weeds, and biodiversity is becoming an important issue in the bio-security agenda worldwide. Invariably, people are designing the kind of ecosystems they find congenial, often for economic or/and aesthetic values leading to a net increase of resultant species richness in their destination in many countries, and is usually at partly least at the expense of local indigenes (and thus reduces global species biodiversity). An introduced species, irrespective of its noble objectives, may escape into the wild, invading native ecosystems punctuated with disastrous consequences: they become alien invasive species (AIS). At the local scale, the emergence of herbicide resistant weeds in many countries is another worrisome phenomenon of modern agriculture. Today no less than 316 biotypes belonging to 183 weed species comprising 110 dicots and 73 monocots and over 290,000 fields are resistant to herbicides, and the numbers are increasing. Of these, 96 biotypes exhibiting resistance to ALS inhibitors top the list. The parallel respective figures for photosystem II inhibitors, ACCase inhibitors, synthetic auxins, bipyridiliums, ureas and amides are 66, 35, 26, 23 and 21 biotypes. Invasives can have devastating impacts, causing extinctions and impacting on natural and cultivated ecosystems. They can transform the structure and species composition of ecosystems by repressing or excluding local indigenes. The rate and risk associated with invasive introductions have been increasing significantly because of a suite of factors, exemplified by escalated anthropogenic activities altering the environment and higher likelihood of species being spread as a result of increased travel, trade and tourism. Also, the increasing human populace is altering the natural biota, and although many of these changes bring about benefits to our societies, others cause inadvertent negative impacts on the goods and services that natural resources deliver to societies or have consequences that are generally unappreciated but quite threatening to many human activities and pursuits. The basis for concern less these herbicide resistant weeds becoming invasive is further aggravated by possible introgression of genes from the introduced GM crops into the weed species, and the overall decrease in genetic diversity within crop species following concentration of breeding programs on a smaller number of high value cultivars. Recent studies showed that the introduction of transgenic cultivars in agriculture has not significantly affected levels of genetic diversity within crop species as shown by the

genetic structure of the elite Roundup Ready® soybean population in North America, using coefficient of parentage (CP) analysis. Only 1% of the variation in CP among lines was related to differences between conventional and herbicide-tolerant lines, whereas 19% of the variation among northern lines and 14% of the variation among southern lines was related to differences among the lines from different companies and breeding programs. Likewise, no significant change was registered in the genetic uniformity among cotton varieties following the introduction of transgenic cotton cultivars. Genetic uniformity actually decreased by 28% over the period of introduction of transgenic cultivars. In fact, the continued use of locally adapted traits gained in traditional breeding should complement the role of biotechnology as a tool for enhancing genetic diversity in crop species through the introduction of novel genes. Decision-makers need to invest more in assessing the potential impacts of recalcitrant invasives before allowing introductions and the associated costs of herbicide resistant weeds following unregulated use of herbicides, especially in resource poor economies, and incorporated bio-security measures once the species have been introduced, or those recalcitrant herbicide resistant weed species have prevailed in the agro-ecosystems. The Convention on Biological Diversity and Herbicide Resistance Action Committee (HRA) offer important opportunities and platforms for addressing the complex global problems of both introduced species and the prevalence of herbicide resistant weed species through improved international cooperation.

Keywords: Herbicide resistant weeds, GM crops, bio-security, transgenics, Convention on Biological Diversity, Herbicide Resistance Action Committee.