Center for Food Safety
660 Pennsylvania Ave., SE, Suite 302
Washington, DC 20003

July 9, 2012

<u>Submitted electronically</u>
Docket No. APHIS-2010-0047
Regulatory Analysis and Development
PPD, APHIS
Station 3A-03.8
4700 River Road, Unit 118
Riverdale, MD 20737-1238

Comments on Final Environmental Impact Statement for Genetically Engineered Glyphosate Tolerant Event H7-1 Sugar Beets

With APHIS's unconditional deregulation of H7-1 or Roundup Ready Sugar Beets (RRSB), the sixth RR crop it has approved, American agriculture becomes still more deeply committed to an entirely unsustainable weed control system based almost entirely on a single tool – the herbicide glyphosate. Prior RR crop systems have fostered epidemic evolution of glyphosate-resistant weeds, and RRSB is already exacerbating this epidemic. Consequences include greater use of toxic weedkillers, more soil-eroding tillage and manual weeding, and dramatically rising production costs. Industry's response to GR weeds – a host of new GE crops immune to multiple, more toxic herbicides – is already beginning to exacerbate these negative trends, promising substantial harm to human health, the environment and farmers. In its Final Environmental Impact Statement (FEIS) for RRSB, APHIS resolutely shuts its eyes to these entirely foreseeable impacts.

APHIS was able to avoid an adequate assessment of these impacts because of several serious flaws in the FEIS. Most basically, APHIS looked backwards rather than forwards, foiling the fundamental purpose of NEPA, which enjoins agencies to assess and mitigate anticipated ***future*** environmental harms ensuing from major federal actions. NEPA environmental assessments are thus forward-looking documents that by their very nature require analysis of contingent matters in which absolute precision is impossible. In contrast, APHIS premised its entire assessment on the completely unwarranted "inherent assumption" that RRSB's future impacts will be consistent with those experienced under partial deregulation in 2009 and 2010.

> "APHIS expects that Alternative 2 (Full Deregulation) ***will result in conditions similar to 2009-2010 after H7-1 sugar beet deregulation and it's widespread adoption***. When available, data from those years or data collected on H7-1 sugar beet were used ***to predict what conditions would occur*** should Alternative 2 be selected." (FEIS at 400, emphasis added).

RRSB and Glyphosate-Resistant Weeds

This two-year, backward-looking timeframe completely misses RRSB's contribution to the rapid evolution of glyphosate-resistant (GR) weeds, and its environmental consequences. GR weeds attributable to RR crops systems first emerged just 12 years ago, and they now infest roughly 17 million acres of cropland. This roughly decade-long development provides a reasonable time frame for assessment of an evolutionary process such as resistant weed emergence. Thus, APHIS should have assessed RRSB with consideration of its impacts ten years into the future.

Glyphosate-resistant weeds in the Midwest region, where 57% of the nation's sugar beets are produced (FEIS at 1), have expanded dramatically (roughly 100-fold increase in acreage infested) over just the first three years of RRSB's commercial production (2008-2010), and there is good reason to expect this trend to continue (see Appendix for discussion). While not all of this expansion can be attributed to RRSB, it is undoubtedly making a substantial contribution. At least three and perhaps four GR biotypes already infest sugar beet fields in the Minnesota and eastern North Dakota (FEIS at 538-539); an astounding 50-70% of sugar beet fields in southern Minnesota are infested with GR waterhemp (FEIS at 260), which has also been identified in hundreds of sugar beet fields in North Dakota. In May 2012, weed scientist Jeff Stachler reported waterhemp resistant to multiple herbicides:

"Based upon additional greenhouse research, multiple resistant waterhemp was confirmed present at least near Holloway, MN (Swift County). In at least one field, waterhemp was confirmed resistant to glyphosate (Group 9), PPO-inhibiting herbicides (Group 14), and ALS-inhibiting herbicides (Group 2). …. Multiple resistant waterhemp is believed to be present in other fields in MN and ND, but have not been confirmed resistant at this time" (Stachler 2012).

This provides still more evidence of how rapidly the herbicide-resistant weed threats are changing and worsening in sugarbeet growing regions.

The leading recommendation to control GR waterhemp is a regime involving five or six herbicides besides glyphosate (FEIS at 260), which could increase herbicide costs for RRSB growers by a massive $133/acre (FEIS at 260). This represents a many-fold increase over the current costs of glyphosate-only weed control in RRSB, estimated at $7 to $18 per acre, and conventional sugarbeets at $45-$55 per acre (FEIS Table III-39 at 291). APHIS even neglects to factor in the technology fee for RRSB in its estimate for the overall costs of herbicidal weed control in RRSB in the table cited above, despite the fact that post-emergence glyphosate use is impossible without the trait. In 2010, the technology fee premium for RRSB was reported to be $131/hectare, or $53/acre (FEIS at 292). Likewise, APHIS admits that other GR weeds will likely trigger increased use of tillage (e.g. GR horseweed, FEIS at 539, 541, 681) and manual weeding, but again excludes any consideration of these impacts in its quantitative assessments (FEIS at 288).

These observations indicate how quickly and dramatically productions costs and impacts of RRSB could rise in the absence of any mandatory measures to prevent or mitigate weed resistance, which APHIS nowhere considered in the FEIS.

APHIS knows that herbicide use patterns for RRSB will change as glyphosate-resistant weeds become more problematic (e.g. FEIS at 260, 543, 689), yet APHIS uses 2011 herbicide use data in their assessments of herbicide impacts, as if this represents what is to be expected after deregulation (FEIS at 429: "Alternative 2 would likely result in herbicide usage patterns similar to what was estimated for H7-1 sugar beet grown in 2011…"). As a result, APHIS underestimates the environmental and health effects from deregulation of RRSB.

For example, in a major Midwestern beet growing region, glyphosate-resistant common waterhemp was "estimated to be present in 50-70% of all sugar beet fields in Southern Minnesota" in 2011 (FEIS at 260). In order to control glyphosate-resistant waterhemp, a leading weed scientist, Jeff Stachler, recommends the use of several different herbicides in addition to glyphosate, including a soil-applied residual herbicide (FEIS at 260, 689).

These recommendations are just beginning to be implemented. For example, in 2011 only 1.4% of RRSB acres in the Midwest region (Minnesota and eastern North Dakota) were actually treated with a residual herbicide (Stachler et al 2012, Table 3, "RR Nort" = Nortron or ethofumesate). Given the rapidly growing extent of the problem, it is highly likely that the use of residuals such as cycloate (RoNeet) will jump quickly amongst RRSB growers in that region, as Stachler advises. RoNeet is not currently used on either conventional or Roundup Ready sugarbeets in the Midwest region (Stachler et al 2012, Table 1)

Use of post-emergence herbicides other than glyphosate by RRSB growers is also likely to increase significantly compared to 2011 data. In fact, Stachler recommends several herbicides for control of glyphosate-resistant waterhemp in RRSB that are currently not listed as being used in RRSB at all – Betamix (a mixture of phenmedipham and desmedipham), Dual Magnum (S-metolachlor) and Outlook (dimethenamid-P) (FEIS at 260 for Stachler's recommendation, FEIS at 429 for summary of herbicides used in 2011: "Of the eight other herbicides used on conventional sugar beet four, desmedipham, dimethenamid-p, phenmedipham, and trisulfuron-methyl, were not used on H7-1 sugar beet.")

APHIS concludes that "non-glyphosate herbicides are expected to decrease 10 to 40 fold or even their use will be discontinued [on RRSB if it is deregulated]"(FEIS at 430), and then proceeds to assess environmental impacts as if this were the case. Instead, it is entirely foreseeable that the continuing rapid emergence of GR weeds in RRSB will drive substantially increased use of these "conventional" sugarbeet herbicides in response. Thus, APHIS's backward-looking assessment greatly underestimated the toxicity of herbicidal weed control to be expected just a few years into the future. Some of the herbicides that will be used to control glyphosate-resistant weeds in RRSB are more toxic to animals and plants than glyphosate. For example, cycloate can result in chronic toxicity to mammals

(FEIS at 486), and cycloate, desmediphan and phenmedipham are all moderately toxic to fish (FEIS at 500).

APHIS's assessment of herbicide use with RRSB makes absolutely no provision for the foreseeable substantial increases in herbicides presently used very little or not at all on RRSB (FEIS at 158, Table III-17).

Harms from gene flow

Sugar beets are varieties of *Beta vulgaris* subspecies *vulgaris* that are grown primarily to extract sucrose from their roots. This species also includes Swiss chard and other leaf beets, table beets, and fodder beets (all varieties of *Beta vulgaris* subspecies *vulgaris*), as well as wild beets (*Beta vulgaris* subspecies *maritima*). They are also closely related to another species of wild beet, *Beta macrocarpa*, which occurs in the US as a weed of sugar beets in California. (FEIS at 66-67). Sugar beets are the first of these beet varieties to be genetically engineered. Because they interbreed with each other, being in the same or closely related species, if Roundup Ready sugar beets are deregulated gene flow from Roundup Ready sugar beets to vegetable beets and wild beets is very likely to occur.

We are concerned about the impacts on farmers in the conventional and organic beet markets of this gene flow from Roundup Ready sugar beets to the other cultivated varieties of beets. Also, the transfer of the glyphosate-resistance trait from Roundup Ready sugar beets to wild beets in California could result in weedy beets that are more difficult to control (FEIS at 467 – 468, but underestimating the role of glyphosate at field margins in selecting rare crosses).

Preventing gene flow within a species has proven to be difficult. Confinement efforts in other crops have often failed, sometimes spectacularly. Conventional corn and rice growers suffered losses in the hundreds of millions of dollars from contamination episodes involving two genetically engineered (GE) crops: StarLink corn (2000/2001) and LibertyLink rice (2006/2007). The organic canola industry in Canada was "destroyed" by pervasive transgenic contamination.

At present, Canada's entire $320 million flax industry is threatened by GE contamination with a long de-registered variety that late in 2009 turned up unexpectedly in flax shipments to the European Union, which has rejected them. There have been over 200 transgenic contamination episodes documented over the past decade, many of which have triggered rejection of shipments by grain elevators or food companies. Conventional and organic growers undertake expensive and often unsuccessful "contamination prevention" efforts, and many also commission expensive testing of their supplies for the presence of unintended transgenic material. Things have reached the point where grain dealers are "offshoring" organic production (e.g. organic seed corn) to foreign countries that are able to ensure production of uncontaminated product, costing American farmers jobs and income.

Vegetable beet seed growers in the US are vulnerable to transgenic contamination from Roundup Ready sugar beets. About half of the vegetable beet seeds in the US are grown in the Willamette Valley of Oregon, in proximity to sugar beet seed producers (FEIS at xxi), and are thus at risk of transgenic contamination with the Roundup Ready trait if Roundup Ready sugar beets are approved for deregulation by APHIS. To sell in sensitive markets, these conventional and organic vegetable beet seed growers will have to pay for expensive testing, and even then will risk losing their markets if customers think contamination is possible. In fact, the Roundup Ready trait has already been detected in some vegetable seed samples after Roundup Ready sugar beets were planted in the Willamette Valley in 2006 (Email exchange between Nick Tichinin, Universal Seed and Neil Hoffman, APHIS, January 2012: APHIS-2010-0047-4656).

APHIS is aware that some vegetable beet seed growers in the Willamette Valley will either have to move to areas where sugar beet seeds are not currently produced, or will go out of business if Roundup Ready sugar beets are deregulated, because their markets are sensitive to transgenic presence, but thinks contamination will be low and manageable (FEIS at 585 – 587, 591).

However, over time, transgenic contamination will be more serious. APHIS underestimates the likelihood of gene flow after deregulation from Roundup Ready sugar beets to other beet varieties because they rely too heavily on the efficacy of voluntary and contractual mitigation measures by the sugar beet industry (e.g. FEIS at xii). At the same time they downplay the importance of small farms and gardens, wildlife plots, and other widespread sources of beet pollen and seeds in the process of gene flow (description of role of gardens in gene flow, FEIS at 203-204; not seriously taken into account in conclusions, e.g. FEIS at xii).

Also, APHIS fails to anticipate large increases in the acreage planted to sugarbeets with the H7-1 glyphosate-resistance trait, and the new areas in which they may be grown, with attendant impacts. For example, as APHIS is aware (FEIS at 71, 282), sugar beets and other beet varieties are being developed for biofuels (Jessen 2012, Pates 2012, Anderson 2010). Under this deregulation, there would appear to be no regulatory review required to introduce the glyphosate-resistance trait into such sugarbeet varieties via conventional breeding (FEIS at 23: "…H7-1 sugar beet and progeny derived from them would have nonregulated status…"). Yet APHIS does not assess the impacts of future development by the biotechnology industry of beets that incorporate this H7-1 event, which will be unregulated and thus open for breeding into any of the beet types

These likely scenarios would greatly expand the acreage and types of beets containing the Roundup Ready trait, and the areas of the country in which they will be grown (Jessen 2012, Pates 2012, Anderson 2010). In fact, the developers of ethanol beets claim that "…a mandate to produce 36 billion gallons of renewable fuels by 2022 opens the door for sugar beets to be used as an alternative fuel… We are in the process of proving that the sugar beet will grow anywhere…" (Anderson 2010) . Furthermore, Betaseed is breeding sugar beets specifically for biofuels - "energy beets" - with plans to expand into areas where sugar beets are not traditionally grown: "We've literally had trials from Nova Scotia to southern California and from Alaska to Florida and I really haven't found a place that I can't grow beets,", said Betaseed's Libsack (Jessen 2012). Thus the sugar industry would no longer be solely in control of stewardship of Roundup Ready beets, and APHIS relies heavily on the tight control of the sugar production chain for mitigating risks of gene flow (e.g. FEIS at 23).

APHIS needs to consider regulatory options to address the increased likelihood and attendant harms from both the foreseeable continued rapid emergence of glyphosate-resistant weeds, and harms from gene flow that would ensue from the scenarios presented above. Unfortunately, the alternatives APHIS considered are not well suited to address these issues. APHIS should choose Alternative 1 until it has the opportunity to further consider these issues.

Appendix on RRSB and Glyphosate-Resistant Weeds

APHIS's assessment of weed resistance in the FEIS is fundamentally flawed in numerous respects as well as deeply biased. CFS presents a few of many possible examples we could cite.

Risk of glyphosate-resistant weed evolution from post-emergence vs. other uses of glyphosate

APHIS relies primarily on the crude and inaccurate metric of "pounds of glyphosate applied" to assess the risk of glyphosate-resistant weed evolution, ignoring the well-established fact that the post-emergence glyphosate use pattern unique to RR crop systems presents a far higher likelihood of fostering resistant weeds than other (preemergence) uses of glyphosate. CFS discussed this well-established fact in great detail in its comments, with reference to a modeling study by weed scientist Paul Neve, who unambiguously found that:

> "Glyphosate use for weed control prior to crop emergence is associated with low risks of resistance. … Post-emergence glyphosate use, associated with glyphosate-resistant crops, ***very significantly increases risks of resistance evolution***" (Neve 2008, emphasis added, discussed in CFS 2010 Science Comments on APHIS's environmental assessment of the partial deregulation petition for RRSB).

Dr. Neve's modeling study is of course strongly corroborated by the empirical observation of an epidemic of glyphosate-resistant weeds that have emerged beginning just four years after the 1996 introduction of the first Roundup Ready (RR) crop, RR soybeans, in the year 2000, as well as the virtual absence of GR weeds in the 22 years of glyphosate use prior to RR crop use. APHIS takes issue with the Dr. VanGessel, who identified the first known GR weed that evolved in an RR crop system, RR soybeans in Delaware:

> "Within 3 years of using only glyphosate for weed control in continuous glyphosate-resistant soybeans, glyphosate failed to control horseweed in some fields" (VanGessel 2001).

APHIS speculates that glyphosate selection pressure from pre-emergence or burndown use of glyphosate prior to RR soybean introduction may have contributed to the GR biotype's emergence, yet offers no evidence of herbicide use or cropping patterns on the field where Dr. VanGessel identified GR horseweed. Instead, APHIS notes that just 8% of Delaware soybean acres were treated with glyphosate in 1994; thus, there is a good chance that the field in question had not been treated with glyphosate pre-emergence in the years prior to cultivation of RR soybeans. Neither does APHIS's quote from a 1993 EPA publication on glyphosate's widespread use (nationally) in the early 1990s offer an iota of support for its speculation. In fact, EPA data show that national agricultural use of glyphosate has increased by an astounding ten-fold since 1993, largely due to RR crops.

However, even if one assumes glyphosate had been used pre-emergence on the field in question prior to RR soybean cultivation, APHIS's speculation begs the question of why many years of preplant use of glyphosate prior to RR crop introduction did not spawn evolution of GR horseweed or other GR weeds in Delaware, or indeed anywhere in the country, until RR crops were introduced! (The sole confirmed report of a GR weed prior to Dr. VanGessel's discovery was of GR rigid ryegrass, infesting less than 10,000 acres of a California almond orchard, in 1998.) Clearly, if preplant use of glyphosate in field crops were at all likely to foster evolution of glyphosate-resistant weeds, then at least a few such GR weed populations would have been identified in the course of the 20 some years of glyphosate used for this purpose. Ironically, APHIS's argument lends support to Dr. VanGessel, Dr. Neve, and the overwhelming consensus of the weed science community that post-emergence use of glyphosate with RR crop systems is overwhelmingly responsible for rapid evolution of GR weeds. Dr. VanGessel's observation stands. Glyphosate-resistant weeds can evolve extremely rapidly, in as little as three years (not the five years presumed by APHIS), when used post-emergence on glyphosate-resistant crops.

APHIS bases its assessment of RRSB's contribution to GR weed evolution primarily on the false assumption that it is proportional to the share of local (FEIS at 651ff), regional (FEIS at 674ff, Table V-2 at 676) and national (694ff) glyphosate use attributable to RRSB, with little regard for how glyphosate is used on it or crops it is rotated with. In particular, APHIS failed to assess with any rigor the risk of GR weed evolution as influenced by the frequency with which an RR crop is present in RRSB crop rotations. This unfortunate lapse skews APHIS's assessment of GR weed evolution particularly in those regions with heavy RR crop presence: the Midwest (Minnesota and North Dakota, where 57% of sugar beets are produced) and the Great Lakes state of Michigan. The roughly 100-fold increase in GR weed-infested acreage in Minnesota and North Dakota since 2007 (CFS Science Comments: Appendix 2, and discussion below), the year before RRSB's introduction, offers strong empirical support for the analysis of Neve (2008), which found that GR weeds evolve more rapidly in synch with the proportion of RR crops and post-emergence glyphosate use in the overall rotation. It is simply not enough to observe that "....maintaining glyphosate selection by rotating exclusively between Roundup Ready crops is not ideal" (FEIS Appendix H at 39). APHIS should have utilized the data collected in Table III-6 (FEIS at 120-122) in this cumulative impacts assessment re: GR weed evolution, as well as the data presented by CFS (see below).

APHIS's continued refusal to conduct any proper assessment of the expansion of GR weeds over time vitiates its assessment of RRSB's contribution to the ongoing epidemic of glyphosate-resistant weeds

In comments on the DEIS for RRSB, CFS documented a dramatic, roughly 100-fold expansion in acreage infested with glyphosate-resistant weeds in Minnesota and North Dakota since 2007, the year before commercial introduction of RRSB (CFS Science Comments 2011 – Appendix 2, which shows maximum infested acreage increasing from just 1,600 acres to over 232,000 acres in these two states). Minnesota and North Dakota together produce 57% of the nation's sugarbeets. These data were collated from the ISHRW website (see below for discussion). CFS provided independent corroboration of these data with reference to a map of Minnesota and North Dakota displaying counties in which GR weeds have emerged from 2007 to 2011 (CFS Science Comments 2011 – Appendix 3). Commenting on the map, its drafters (North Dakota weed scientists Jeff Stachler and Mike Christoffers) stated: ***"It is truly astonishing to realize the speed at which these [glyphosate-resistant] weeds are appearing."*** Many of the counties in which GR weeds have been detected are sugarbeet growing counties in the Red River Valley, and there is little doubt that RRSB has contributed to the emergence of these GR weeds, and will continue to do so in the future. According to Jeff Stachler and colleagues: "With the rapid introduction of glyphosate-resistant sugar beet and the continued use of glyphosate-resistant corn and soybean in the rotation, glyphosate-resistant common ragweed will become more challenging to control in sugar beet."[1]

In just the year or two since that statement was made, GR waterhemp has exploded onto the scene, and according to APHIS is now found in 50-70% of sugarbeet fields in southern Minnesota (FEIS at 260). Clearly, tracking the rate of expansion of GR weeds (whether independently selected for in RR crops, or dispersed from pre-existing populations) is crucial to any assessment of their impacts. Thus, it is disappointing to see APHIS continue to dismiss hard data on GR weed emergence presented to it by CFS.

CFS has for several years collated data from the International Survey of Herbicide-Resistant Weeds (ISHRW), an online database of herbicide-resistant weeds, and used these data to analyze trends in GR weed emergence in comments to APHIS on its decision documents for RRSB and various other RR crop systems. CFS appended several documents based on ISHRW data to one set of its science comments on the DEIS for RRSB, and discussed these data in the body of its comments. The ISHRW data collated and analyzed by CFS include acreage infested by GR weeds since November 2007, both nationally and in sugarbeet states. CFS also presented data on crop settings in which GR weeds have emerged.

APHIS refused to utilize these data presented by CFS (see FEIS Appendix H at 31-33 for the following discussion). APHIS based this decision on the comments of Ian Heap, a weed scientist who manages the ISHRW database and website. The ISHRW is funded by a consortium of pesticide firms known as the Herbicide Resistance Action Committee

[1] Stachler, J.M et al (2010). "Management of glyphosate-resistant common ragweed," North Central Weed Science Society Proceedings 64: 178.

(HRAC). Dr. Heap is presumably compensated by HRAC for his services in managing the website.

APHIS maintains that CFS misinterprets the ISHRW data it presented in Table 1 and Figure 1 of its comments on the DEIS (CFS Science Comments 2011). Table 1 presents national data on the minimum and maximum sites and acreage infested with GR weeds collated from ISHRW reports on eight separate dates from November 21, 2007 to December 12, 2011. Figure 1 presents the minimum and maximum acreage infested data in the form of a bar graph.

Neither APHIS nor Dr. Heap offer a coherent rationale for dismissing these data, and there is much evidence that they are indeed valid and should have been utilized by APHIS. First, it should be noted that ISHRW presents data on sites and acreage infested with HR weeds in up to 10-fold ranges (e.g 10,001 to 100,000 acres), due to the difficulty of gauging the precise extent of any resistant weed population by way of a point estimate (e.g. 10,000 acres). In Table 1 and Figure 1, CFS presented aggregate data accurately reflecting aggregate minimum and maximum acreage infested with GR weeds. Neither Dr. Heap nor APHIS questions the accuracy of the figures. Instead, APHIS and Dr. Heap dispute CFS's contention that the maximum acreage figures better reflect actual conditions in the field than the minimum acreage figures. Yet CFS based this contention on an estimate provided by Dr. Heap himself!

In prior CFS comments on the draft environmental assessment for partial deregulation of RRSB,[2] CFS stated:

> "Acreage infested [with GR weeds] has also increased dramatically, and according to Dr. Ian Heap (who manages the ISHRW website) now lies near the upper-bound estimate of 12.4 million acres. In May of 2010 (when the upper-bound estimate was 11.4 million acres), Dr. Heap estimated the extent of GR weed infestation in the U.S. at 6% of the 173 million total acres planted to corn, soybeans and cotton, the three major RR crops, which comes to 10.4 million acres." (EA at 93, citing WSSA (2010). "WSSA supports NRC Findings on Weed Control, May 27, 2010).

In his remarks quoted by APHIS in Appendix H (31-33) of the FEIS, ***Dr. Heap now denies any validity to the acreage infested figures on the very website he manages.*** This begs several important questions. First, why include any data on acreage infested with HR weed populations if they are nothing but "very subjective guesses." Second, on the basis of what evidence does Dr. Heap so cavalierly dispute the estimates provided by on-the-ground researchers? Obviously, Dr. Heap will know far less about the specifics of any given HR weed population than researchers who spend months and sometimes years actually studying them prior to submitting a report to ISHRW. Third, on what basis did Dr. Heap himself arrive at a point estimate of "about 10 million acres" infested with GR weeds (Appendix H at 31), if not the ISHRW data that he manages? Fourth, why does Dr. Heap presume to provide a point estimate rather than, as CFS does, accurately cite a range for

[2] These draft EA comments were appended to CFS's DEIS comments, and explicitly made part of the record.

infested acreage, only then carefully explaining its reasons for utilizing upperbound estimates in its discussion? Finally, Dr. Heap's remarks make clear that he discusses acreage infested estimates with researchers, and sometimes encourages them to lower their estimates, so ISHRW data reflect at least in part his critical review of estimates made by contributing researchers.

APHIS completely fails to address the additional evidence cited by CFS for use of the maximum acreage infested figures. "First, no acreage estimates are given for 9 of the 79 [GR weed] reports. Second, since 61 of the 79 GR weed populations are expanding in range, and there is no mechanism for regular updating of reports, some populations are likely larger than indicated. Finally, the ISHRW reporting system is voluntary, and "the voluntary basis of the contributions likely results in underestimation of the extent of resistance to herbicides, including glyphosate (see NRC 2010, p. 2-12)" (from caption to Figure 1, CFS Science Comments 2011). Note that the reference to NRC 2010 is a quote from a prestigious National Research Commission report on genetically-engineered crops, referring directly to the ISHRW database.

Further APHIS comments along the same lines are equally spurious. CFS noted that over 99% of the acreage infested with GR weeds emerged in soybeans, cotton, corn and/or sugarbeets, all crops that are predominantly Roundup Ready (Appendix H at 32; CFS Science Comments 2011, p. 5), and included an itemized list of all GR weed populations and the acreage they infest based on ISHRW to document this statement. APHIS's response is merely to repeat Dr. Heap's comment about the data on the ISHRW database he manages and himself uses as being "very subjective guesses" that should "only be used as general indications on how widespread a resistant weed has become." CFS would be happy if APHIS were to take the "over 99% figure" (the accuracy of which it does not dispute) as even a "general indication" of how RR crops are overwhelmingly responsible for fostering evolution of glyphosate-resistant weeds, as universally acknowledged in the weed science community. Unfortunately, APHIS continues to obfuscate this point, for instance by giving the outrageously false impression that glyphosate-resistant weeds are as much of a problem in non-agricultural and orchard settings as in Roundup Ready crops (FEIS at 232-233).[3] In fact, CFS took such pains to provide hard data on this point precisely to correct the false impression created by APHIS with intentionally misleading statements such as this.

APHIS also claims that CFS "ignores the impact [on GR weed evolution] from years of glyphosate use on non-Roundup Ready crops," correctly stating that glyphosate was used for 20 years before RR crops were introduced. As explained above, the very absence of GR weed populations over this 20-year period, coupled with their epidemic emergence beginning just four years after RR crops were introduced, corroborates beyond doubt the overwhelming contribution of post-emergence use of glyphosate unique to RR crops as the key factor promoting GR weed evolution, as stated also by Dr. Neve in the quote cited above.

APHIS insists that rotation among GR crops inhibits evolution of glyphosate-resistant weeds (Appendix H at 32-33). Unfortunately for APHIS's biased position, the weed science

[3] It should be noted that APHIS's reference to Table 3-23 (FEIS 233, table itself at FEIS 244) is mistaken. The table does NOT refer to the crop or non-crop settings in which glyphosate-resistant weeds in particular have emerged, but rather the settings in which herbicide-resistant weeds in general have emerged.

community understands quite well that rotation provides little help in preventing GR weeds as the number of GR crops in the rotation rises. Most relevant to RRSB is the following passage from Minnesota and North Dakota weed scientists Jeff Stachler and colleagues, which was cited in our 2010 comments on APHIS's environmental assessment of the petition to partially deregulate RRSB:

> "Jeff Stachler and colleagues, in the two leading sugar beet production states of Minnesota and North Dakota, likewise have warned: "With the rapid introduction of glyphosate-resistant sugar beet and the continued use of glyphosate-resistant corn and soybean in the rotation, glyphosate-resistant common ragweed will become more challenging to control in sugar beet."[4]

APHIS cites numerous works of Dr. Stachler in the FEIS, but neglects to reference this abstract. Further comments from the same 2010 CFS comments follow:

----- Start of Excerpt -----

APHIS relies heavily on the proposition that, even if glyphosate alone is used with RRSB, other weed control tactics used on crops that are rotated with sugar beets will succeed in preventing evolution of GR weeds, even if the only crops rotated with RRSB are also glyphosate-resistant.[5] This position directly contradicts the consensus view of the weed science community, as APHIS is well aware. The NRC Committee cited above addressed this very question, and concluded that any value of crop rotation in preventing GR weeds is largely negated by overreliance on glyphosate when all the crops in the rotation are glyphosate resistant. In a section entitled *Developing weed management strategies for herbicide-resistant crops,"* the NRC stated: "As for using crop rotations, the increasingly common practice of farmers throughout the United States of using glyphosate as the primary or only weed-management tactic in rotations of different glyphosate-resistant crops limits the application of the rotation strategy…"[6]

The imperative to rotate away from a Roundup Ready crop to a conventional one to prevent GR weed evolution has been acknowledged since the very first GR weed was documented in the late 1990s. According to Dr. Ian Heap, who has extensive knowledge of herbicide-resistant weeds by virtue of his position as organizer of the ISHRW discussed above:

> "The appearance of glyphosate-resistant rigid ryegrass should be a forewarning. The recently developed glyphosate-resistant crops will need to be used in rotation with conventional cultivars and in conjunction with non-chemical weed control and other herbicides if the selection of glyphosate-resistant weeds is to be avoided."[7]

Unfortunately, Dr. Heap's warning and those of many other agronomists have been ignored. As GR weeds are on course to expand dramatically in the coming years, APHIS continues to ignore it.

---

[4] Stachler, J.M et al (2010). "Management of glyphosate-resistant common ragweed," North Central Weed Science Society Proceedings 64: 178.

[5] EA at 94.

[6] NRC (2010), op. cit., pp. 2-19, 2-20.

[7] Heap, I.M. (1997). "The occurrence of herbicide-resistant weeds worldwide," Pesticide Science 51: 235-43.

There is nothing unique about RR sugar beets that alters the situation. USDA's Agricultural Research Service recently noted that "…transgenic beets present new problems in prevention of weed resistance to this important herbicide, given the large number of weed species in sugar beet fields…," but unfortunately has no funding to address the issue.[8] Jeff Stachler and colleagues, in the two leading sugar beet production states of Minnesota and North Dakota, likewise have warned: "With the rapid introduction of glyphosate-resistant sugar beet and the continued use of glyphosate-resistant corn and soybean in the rotation, glyphosate-resistant common ragweed will become more challenging to control in sugar beet."[9]

----- End of excerpt ------

Weed resistance to glyphosate with RRSB is much more likely than weed resistance to other herbicides used with conventional sugarbeets

APHIS equates the weed resistance harms of growing conventional beets and RRSB, when in fact glyphosate-resistant weeds are much more likely to evolve and cause harm on land planted to RRSB than weeds in conventional beets to evolve resistance to "conventional" herbicides. This conclusion follows from first principles of weed science, and also has strong empirical support. First, herbicides used in conventional sugarbeets are used almost exclusively on sugar beets and not on other crops. Second, conventional sugarbeets are generally treated with mixtures of herbicides with different modes of action, often five or more. Third, sugarbeets are grown on a given field only once every 3-5 years, with different crops and different herbicides used in the two to four non-beet years of the rotation. Thus, cultivation of conventional sugarbeets involves three key weed resistance management practices: 1) Use of premix herbicides with different modes of action; 2) Rotation of crops; and 3) Rotation of herbicide modes of action.

Consider the converse case for glyphosate-resistant weed evolution with RRSB. First, glyphosate is used more heavily on RRSB than any other field crop: 2.7 lbs. a.i. per acre per season in the Midwest, meaning extremely high selection pressure for resistance. Second, RRSB is frequently rotated with one or more other RR crops (corn, soybeans, alfalfa) that also involve heavy reliance on glyphosate, increasing glyphosate selection pressure through some or all of the non-beet rotation years. RRSB is rotated with RR crops particularly in the Midwest (Minnesota and North Dakota) and Great Lakes (Michigan) regions, where a substantial portion of sugarbeets are grown. Third, the post-emergence use of glyphosate – which is both unique to RR crop systems and much more likely to foster resistant weeds than other uses of glyphosate – increases risks of GR weed evolution when the RRSB rotation involves other RR crops. Finally, glyphosate tends to be used exclusively or nearly exclusively on RRSB and other RR crops. Thus, two of the three weed resistance management measures described above with conventional sugarbeet rotations are largely absent on much of the land where RRSB is grown in rotation with other RR crops. Neither

[8] USDA ARS Action Plan 2008-13 – App I. "National Program 304: Crop Protection and Quarantine Action Plan 2008-2013," Appendix 1, p. 65. http://www.ars.usda.gov/SP2UserFiles/Program/304/ActionPlan2008-2013/NP304ActionPlanwithCover2008-2013.pdf.

[9] Stachler, J.M et al (2010). "Management of glyphosate-resistant common ragweed," North Central Weed Science Society Proceedings 64: 178.

herbicide mixes nor herbicide rotation are much used in these common situations. And the one remaining measure – crop rotation – is of little use when the rotation is dominated by RR crops.

One would thus expect much worse weed resistance to glyphosate with RRSB than to conventional herbicides with conventional sugarbeets. The ISHRW provides empirical support for this position. GR weed-infested land in Minnesota and North Dakota has expanded roughly 100-fold since 2007, the first year of RRSB's commercial cultivation, and a significant proportion of this land being used to grow sugarbeets and its rotation partners. Fully 50-70% of southern Minnesota sugarbeet fields are infested with GR waterhemp.

In contrast, over the past 20 years there have been only three reports of weeds evolving resistance to herbicides in sugarbeets: in 1990, 1991 and 2005 (for the following, see HR Weeds from ISHRW – 11-30-10.xlsx, submitted as supporting material for CFS Science Comments 2010 on the draft EA for partial deregulation of RRSB). The 1990 report involved wild oat resistant to diclofop-methyl, fenoxaprop-P-ethyl and tralkoxydim (ACCase inhibitors) in Montana, and emerged on 1,001 to 10,000 acres in cropland, sugarbeet and wheat. The 1991 report involved wild oat resistant to diclofop-methyl in Minnesota (ACCase inhibitors), and emerged on 1,001 to 10,000 acres of sugarbeet and wheat. The 2005 report involved kochia resistant to imazamox and triflsulfuron-methyl (ALS inhibitors), and emerged in sugarbeet on up to 500 acres in Michigan.

Of the herbicides to which these weed populations have documented resistance, only triflusulfuron-methyl is listed by APHIS as a sugarbeet herbicide in the FEIS. It is true that some of these resistant populations may have cross-resistance to sugarbeet herbicides in the same families (weeds resistant to specific ALS inhibitors and ACCase inhibitors often display some level of cross-resistance to multiple herbicides from these families). It is also not known whether these HR weeds have declined or expanded in range, or still exist at all. Yet the upshot is clear. Over the past 20 years, there are extremely few documented reports of weeds resistant to herbicides used on conventional sugarbeets emerging in sugarbeet fields. In contrast, glyphosate-resistant weeds have been emerging at an extremely rapid rate in Roundup Ready sugarbeet fields since just 2007.

APHIS's attempt to portray Alternative 1 as promoting weed resistance to conventional sugarbeet herbicides is thus a substantial exaggeration, and is apparently intended to confuse and distract the reader from the real issue: the ongoing epidemic of glyphosate-resistant weeds exacerbated by APHIS's partial and now full deregulation of RRSB.

APHIS creates unreal distinction between RRSB and RR crops it is often rotated with to deny that RRSB contributes to GR weed evolution

Sugarbeets, whether conventional or RRSB, are only grown in a given field only once every 3-5 years, in rotation with other crops. This is because rotation is needed to replenish the soil, and more importantly to suppress soilborne pathogens and nematodes that cause sugarbeet diseases and damage that would build up and cause unacceptable crop injury if sugarbeets were grown year after year on the same field (FEIS at 117). In contrast, the evolution of resistant weeds is a multi-year process, though it can occur in as little as three years with continual use of an RR crop system (VanGessel 2001). APHIS maintains that "no glyphosate-resistant weeds have been attributed to the production of H7-1 sugar beet…." (FEIS at 537), though elsewhere concedes that "glyphosate-resistant common waterhemp had become very prevalent where it was estimated to be present in 50-70% of all sugar beet fields in Southern Minnesota" by the 2011 growing season (FEIS at 260). APHIS resolves this apparent contradiction with the claim that all GR weeds found in sugarbeets fields are due to "dispersal from other sources" (FEIS at 537), though it offers no reference for this claim.

First, it should be noted that APHIS continually downplays the severity of the GR weed epidemic emerging in sugarbeet fields of the Midwest region. APHIS states: "After 4 years, the first reports of GR weeds being found in sugar beet fields are ***just beginning in the Midwest***, and there are no reports of GR weeds in sugar beet fields in other regions (see sec. III.C.3)." (FEIS Appendix H at 42). This statement is in obvious contradiction to the presence of GR waterhemp in 50-70% of all sugar beet fields in southern Minnesota, noted above.

Stachler & Luecke (2010) report that: "Two major reasons for the increase in waterhemp include excessive rainfall causing movement of seeds from one area to another area and the increased frequency of glyphosate-resistant waterhemp populations." While some GR waterhemp is likely from seed dispersal from other fields, RRSB likely contributes to the increased frequency of GR waterhemp populations on land rotated between RRSB and RR corn and/or RR soybeans. This is supported by a recent report of GR common waterhemp that was explicitly reported as infesting "corn, cotton and sugarbeets" in North Dakota. CFS brought this report to the attention of APHIS in comments on the DEIS, and discussed it as well.

<u>Excerpt from CFS DEIS comments: p. 9:</u>
More challenging still is glyphosate-resistant waterhemp. A substantial population of GR waterhemp on hundreds of sites covering up to 10,000 acres was recently confirmed in the North Dakota county of Richland, which had 29,350 acres of sugar beets in 2007 (see report below and Appendix 3 for location, acreage data from 2007 Census of Agriculture). The GR waterhemp is thus infesting a sizeable proportion of the sugar beets in that county. Appendix 3 shows a startling increase in the number of GR waterhemp foci (mostly suspected) in sugar beet counties since just 2009, suggesting that this is the most aggressively expanding GR weed in sugar beet country of the Red River Valley.

QUIK STATS (last updated Nov 14, 2011)	
Common Name	**Common Waterhemp**
Species	*Amaranthus tuberculatus (syn. rudis)*
Group	Glycines (**G/9**)
Herbicides	glyphosate
Location	USA, North Dakota
Year	2010
Situation(s)	corn, soybean, and sugarbeet
Sites	101-500 Limitations of Site and Area Estimates
Acres Infested	1001-10000
Contributors	Jeff Stachler
Input Data	Edit this Case | Add New Case of Resistance | Add Note

Accessible at: http://www.weedscience.org/Case/Case.asp?ResistID=5575, last visited Dec. 12, 2011.
---------- End of excerpt --------------

Heavy post-emergence use of glyphosate with RRSB in rotation with RR corn and/or RR soybeans is likely responsible for GR waterhemp's emergence in at least some of the 101-500 sites where it is reported in North Dakota. The weed emerged in 2010, after two years of widespread RRSB cultivation; sugarbeets are very commonly rotated to corn and soybeans in North Dakota, with sugarbeets (nearly all RRSB) followed by soybeans on 55% and corn on 15% of sugarbeet acreage; and a high percentage of both soybeans (94%) and corn (71%) are Roundup Ready in North Dakota (FEIS Table 3-6 at 121). This makes it quite likely that the corn, soybean and sugarbeet growing land where this GR waterhemp emerged was subject to frequent exposure to post-emergence glyphosate in rotations involving RRSB and one or two other RR crops. Both in this example and the more widespread GR waterhemp in Minnesota, it should be noted that it would be extremely difficult to distinguish populations that arise due to seed dispersal from another area, versus glyphosate selection pressure on site. Only molecular analysis might be able to decide this question.

APHIS's claim that "no glyphosate-resistant weeds have been attributed to the production of H7-1 sugar beet…." (FEIS at 537) may also be a clever attempt at obfuscation. Because RRSB is always grown in rotation with other crops, and resistant weed evolution is a multi-year process, one cannot attribute GR weed evolution ***solely*** to RRSB because of the very nature of sugarbeet cultivation and weed resistance; yet it is undeniable that RRSB is making and will continue to make a strong contribution to GR weed evolution as outlined above.

APHIS ignores how glyphosate-resistant weeds fostered in part by RRSB could harm the interests of other farmers

APHIS nowhere considers how GR weeds fostered in RRSB farmers' fields (especially those who grow RRSB in rotation with other RR crops) could afflict non-RRSB farmers, and impose costs on them. For instance, Stachler notes that 11% of conventional sugarbeet acreage in MN and eastern ND were treated preemergence with glyphosate in 2011. These growers who have little or no part in fostering GR weeds could lose glyphosate as an effective control tool for preemergence use thanks to RRSB growers who use glyphosate post-emergence, in a way much more likely to foster GR weeds.

Likewise, wheat growers make considerable preemergence use of glyphosate. They, too, could see glyphosate degraded as a control tool for their uses, necessitating use of additional herbicides, tillage or other control tools, at increased costs.

These threats are amplified by the dispersal of GR weeds via seed transport, for instance via flooding, as noted by APHIS and Dr. Stachler above. GR weed dispersal also constitutes a disincentive for any grower to practice weed resistance management, since many farmers will judge the expenditures involved to be useless, or at least highly risky, if their efforts to forestall GR weed emergence can be easily undermined by GR weed dispersal from less careful neighbors' fields. This collective action problem argues for regulation to ensure high compliance with GR weed prevention measures, yet APHIS does not consider any such measures in the FEIS.

References

Anderson, A. (2010) 'Energy' beet ethanol, coming to America. EnergyBoom, December 10, 2010; http://www.energyboom.com/yes/'energy'-beet-ethanol-coming-america

Bartsch, D., and Ellstrand, N.C. (1999). Genetic evidence for the origin of Californian wild beets (genus Beta). Theor. Appl. Genet. 99: 1120–1130.

Jessen, H. (2012) Energy beats: who will leap first? Ethanol Producer Magazine, April 11, 2012; http://www.ethanolproducer.com/articles/8707/energy-beets-who-will-leap-first

Neve, P. (2008). "Simulation modeling to understand the evolution and management of glyphosate resistance in weeds," Pest Management Science 64: 392-401.

Pates, M. (2012) Sugar beet-to-ethanol. Agweek April 2, 2012; http://www.agweek.com/event/article/id/19705/

Stachler, JM and Luecke JL (2010). Control of waterhemp in glyphosate-resistant sugarbeet," 2010 North Central Weed Science Society Conference Proceedings 65: 230.

Stachler, J (2012). "Herbicide resistance in waterhemp in MN and ND and Management in Sugarbeet, Corn and Soybean (5/24/12). http://www.ag.ndsu.edu/homemoisture/cpr/weeds/herbicide-resistance-in-waterhemp-in-mn-and-nd-and-management-in-sugarbeet-corn-and-soybean-5-24-12

Stachler, JM et al (2012). "Survey of weed control and production practices on sugarbeet in Minnesota and eastern North Dakota in 2011."

VanGessel (2001). "Glyphosate-resistant horseweed from Delaware," Weed Science 49: 703-705.