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OPP Docket
Environmental Protection Agency Docket Center
(EPA/DC), (28221T)
1200 Pennsylvania Ave. NW
Washington, DC 20460–0001

Re: Draft Proposal to Improve Pest Resistance for Plant-Incorporated Protectants [EPA-HQ-OPP-2019-0682]

Dear Sir/Madam,

These comments are submitted on behalf of Beyond Pesticides. Founded in 1981 as a national, grassroots, membership organization that represents community-based organizations and a range of people seeking to bridge the interests of consumers, farmers and farmworkers, Beyond Pesticides advances improved protections from pesticides and alternative pest management strategies that reduce or eliminate a reliance on pesticides. Our membership and network span the 50 states and the world.

We are writing in response to the call for comments on EPA's proposed new framework to address the developing resistance of lepidopteran pests in *Bacillus thuringiensis*-based (Bt) corn and Bt cotton. This proposed framework is consistent with the recommendations received from the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) Scientific Advisory Panel (SAP) and addresses stakeholder comments thus far received from the public. The ability of lepidopteran pests to develop resistance to Bt toxins was known even as transgenic Bt corn and Bt cotton were being considered.[1] The agency was warned about evolving pest resistance in Bt crops when these plant incorporated protectants (PIPs) were first considered for registration and shortly after as pest resistance to Bt toxins became manifest. Existing agency efforts to prevent or impede advance of this resistance have been unsuccessful, and we agree with the unanimous consensus of the SAP regarding the many documented cases of Bt resistance for *Helicoverpa zea* (corn earworm, cotton bollworm), *Spodoptera frugiperda* (fall armyworm), and *Striacosta albicosta* (western bean cutworm) for specific Bt toxins that have rendered most

[1] Stone, T.B. and Sims, S.R., 1993. Geographic susceptibility of Heliothis virescens and Helicoverpa zea (Lepidoptera: Noctuidae) to Bacillus thuringiensis. *Journal of Economic Entomology*, *86*(4), pp.989-994.

single trait and many pyramidal trait products ineffective in broad corn and cotton areas. We find the agency's new resistance management framework as proposed with only minor changes to existing practices will likely prove unsuccessful in the long run as well.

The agency is proposing changes to three aspects of lepidopteran insect resistance management that consist of new resistance definitions, increased resistance monitoring, and mitigation efforts, and modified annual reporting to the agency. These changes do not address or impact the biology of pest populations developing resistance, but only the recognition and identification of such resistance. In addition to the above proposed framework changes, the agency is considering options to phase down single trait and non-functional pyramids, increase percent of refuge in seed blend products, and changes to refuge compliance measures. These options at best will only delay the development of more prevalent pest resistance to Bt toxins.

In Bt corn and Bt cotton, there is a variety of transgenic proteins derived from the bacteria *Bacillus thuringiensis* that express insecticidal properties. Seed products available may consist of seeds with a single Bt protein toxin (single trait) or multiple Bt toxins (pyramid and/or stacked). A pyramid hybrid includes two or more Bt traits attacking the same pest. A stacked hybrid would include one aboveground Bt trait and one belowground Bt trait. A stacked and pyramided hybrid include multiple aboveground and belowground Bt traits. As generally expected, single trait products develop resistance and become non-functional sooner than in pyramided and stacked products.

The principal means for delaying evolution of pest resistance to Bt crops has been use of refuges and pyramid/stacked transgenic hybrids. Refuges are blocks of plants that do not produce Bt toxins and thus allow survival of susceptible pests. Similarly, refuge-in-a-bag (RIBs) products, a pre-mixed seed mixture that yield random distributions of Bt plants and non-Bt plants within the same field, are used. Although use of pyramids and refuges may delay resistance evolution, eventual development of resistance to Bt toxins in transgenic corn and cotton is still expected.[2,3,4]

The option to increase refuge block size or proportion of non-Bt seed in RIB products to impede resistance development has the negative consequence of increasing chemical insecticide use. Continued reliance on chemical or PIP insecticides only continues the cycle of pests developing resistance and continued need for new chemistry or technologies. Options not considered in the many presented in the agency's new resistance management framework include use of agricultural practices like crop rotation and the employment of biological control

[2] Powell, K., 2003. Concerns over refuge size for US EPA-approved Bt corn. Nature Biotechnology, Vol 21 (5): 467-468.
[3] Carrière, Y., Fabrick, J.A. and Tabashnik, B.E., 2016. Can pyramids and seed mixtures delay resistance to Bt crops?. *Trends in biotechnology*, *34*(), pp.291-302.
[4] Brévault, T., Heuberger, S., Zhang, M., Ellers-Kirk, C., Ni, X., Masson, L., Li, X., Tabashnik, B.E. and Carrière, Y., 2013. Potential shortfall of pyramided transgenic cotton for insect resistance management. *Proceedings of the National Academy of Sciences*, *110*(15), pp.5806-5811.

measures and enhancements. Crop rotation is a good management option because it reduces the possibility of existing pests developing resistance to a particular insecticide by providing a pest population a break from continually being subjected to selection pressure from insecticide use.[5] Crop rotation is more advantageous than use of refuges in that additional insecticide use may be avoided. Likewise, a variety of biological controls as alternatives to reliance on insecticide treatments are available and can be encouraged with proper management for *Helicoverpa zea*,[6,7] *Spodoptera frugiperda*,[8] *Striacosta albicosta*,[9] as well as other lepidopteran pests resistant to Bt crops.[10,11,12,13] In fact, insecticide treatments would be problematic in sustaining populations of biological agents effective against crop pests and continue the cycle of further reliance on chemical or PIP products.

In summary, we find that the proposed new resistance management framework with new resistance definitions, increased resistance monitoring and mitigation efforts, and modified annual reporting to the Agency will do little to curb the trajectory in the increasing resistance from Bt toxins in lepidopteran pests. We would support the proposed option for phasing out single trait and non-functional pyramids and removing these PIPs from the market. However, we do not support increasing the size of refuge blocks or percent refuge in seed blend products and in changes to encouraging/enforcing refuge compliance as this would lead to increased use of chemical insecticides. Instead, we would encourage incorporating biological control procedures into best management practices (BMPs) and integrated pest management (IPM) strategies for mitigating lepidopteran resistance in Bt crops. The agency should further coordinate and cooperate with the USDA/National Institute of Food and Agriculture Integrated

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[5] Carrière Y, Brown Z, Aglasan S, et al. 2020. Crop rotation mitigates impacts of corn rootworm resistance to transgenic Bt corn. *Proc Natl Acad Sci U S A*. 117(31):18385-18392.
[6] Lopez, D.C. and Sword, G.A., 2015. The endophytic fungal entomopathogens Beauveria bassiana and Purpureocillium lilacinum enhance the growth of cultivated cotton (Gossypium hirsutum) and negatively affect survival of the cotton bollworm (Helicoverpa zea). *Biological Control*, *89*, pp.53-60.
[7] Gross Jr, H.R. and Pair, S.D., 1986. The fall armyworm: status and expectations of biological control with parasitoids and predators. *Florida Entomologist*, pp.502-515.
[8] Hoballah, M.E., Degen, T., Bergvinson, D., Savidan, A., Tamo, C. and Turlings, T.C., 2004. Occurrence and direct control potential of parasitoids and predators of the fall armyworm (Lepidoptera: Noctuidae) on maize in the subtropical lowlands of Mexico. *Agricultural and Forest Entomology*, *6*(1), pp.83-88.
[9]Michel, A.P., C.H. Krupke, T.S. Baute et al. 2010. Ecology and management of the western bean cutworm in corn and dry beans. J. Integ. Pest Mngmt. 1(1):1-10.
[10] Hoballah, M.E.F. and Turlings, T.C., 2001. Experimental evidence that plants under caterpillar attack may benefit from attracting parasitoids. *Evolutionary ecology research*, *3*(5), pp.583-593.
[11] Jackson, J.J. 1996. Field performance of entomopathogenic nematodes for suppression of the western corn rootworm. J. Econ. Entomol. 89(2):366-372.
[12] Rudeen, M.L., S.T. Jaronski, J.L. Petzold-Maxwell et al. 2013. Entomopathogenic fungi in cornfields and their potential to manage larval western corn rootworm Diabrotica virgifera virgifera. J. Invert. Pathol. 114:329-332.
[13] Hoffmann, M.P. 1998. Early season establishment of Trichogramma ostriniae for season long suppression of European corn borer in sweet corn. In: 1997 New York State Vegetable Project Reports Relating to IPM. NY IPM Pub. No. 123, pp. 143-146.

Pest Management Program to further research and deploy biological control methodologies against lepidopteran pests in corn and cotton crops as a more sustainable option to effectively control lepidopteran pests.

Respectfully,

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