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OFFICE OF CHEMICAL SAFETY
AND POLLUTION PREVENTION

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MEMORANDUM

SUBJECT: **Broflanilide:** Comparison of Hazard and Chemical/Fate Properties for Several Alternative Insecticides

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The purpose of this memo is to provide a comparison of the toxicity and fate/chemical properties of the proposed new chemical broflanilide to other diamide pesticides as well as alternative compounds (as recommended by team members from BEAD), for the proposed uses on various agricultural crops (**Table 1 and Table 2**). Specifically, EFED compiled the most sensitive toxicity endpoints for these chemicals and broflanilide to birds, mammals, honey bees, fish, aquatic invertebrates, and plants. These tables provide a comparison of available data on a chemical-by-chemical basis. To illustrate the range of toxicity, a difference of 10x was selected to designate whether an alternative is less (shaded in green) or more toxic (shaded in pink), relative to broflanilide (**Table 1**).

In comparison to the alternative chemicals, broflanilide is generally similarly or less toxic than the other chemicals for birds. Broflanilide is less or equally toxic to mammals than the other chemicals on an acute basis, but there is more of a mixed pattern on a chronic basis. Honey bee data is fairly limited across the chemicals; where comparisons can be made, broflanilide is more or equally toxic than the other chemicals. Fish acute and chronic data suggest that broflanilide is more toxic than the neonics and tebupirimphos, but less toxic or equal in toxicity when compared to the other chemicals. Aquatic invertebrate data for broflanilide show that broflanilide is generally more toxic than the other chemicals. Aquatic and terrestrial plant endpoints are often non-definitive, so comparisons between

chemicals are less certain. However, the data suggest generally similar toxicity to plants across the compounds.

A comparison of broflanilide toxicity to other diamide compounds is also presented (**Table 2**). In comparison to other diamide chemicals, broflanilide is of similar toxicity to birds, mammals, and plants. Honey bee and aquatic invertebrate data show that broflanilide is significantly (orders of magnitude) more toxic than the other diamide chemicals.

Table 3 summarizes the environmental fate and chemical properties of these pesticides to show the relative persistence and mobility expected in the environment. Broflanilide is slightly mobile, and with the exception of potential degradation through aqueous photolysis in well-lit, shallow, clear water, is stable and expected to persist in most aquatic and terrestrial environments. The data suggest that broflanilide is more similar to flubendiamide than the other diamides, being more persistent across all degradation pathways and less mobile. The alternatives are nearly all more mobile and less persistent than broflanilide.

Table 1. Comparison of the Toxicity of Broflanilide to Alternative Insecticides

Pesticide:		Broflanilide	Imidacloprid	Thiamethoxam	Clothianidin	Fipronil	Tefluthrin	L-cyhalothrin	Zeta-cypermethrin	Cyfluthrin	Bifenthrin	Phorate	Malathion	Chlorpyrifos	Tebupirimphos	Terbufos
PC Code:		**283200**	**129099**	**060109**	**044309**	**129121**	**128912**	**128897**	**129064**	**128831**	**128825**	**057201**	**057701**	**059101**	**129086**	**105001**
Class:		**Diamide**	**Neonicotinoid**	**Neonicotinoid**	**Neonicotinoid**	**Phenyl-pyrazole**	**Pyrethroid**	**Pyrethroid**	**Pyrethroid**	**Pyrethroid**	**Pyrethroid**	**OP**	**OP**	**OP**	**OP**	**OP**
Crops		**wheat, corn, potato**	**potato**	**wheat, corn, potato**	**wheat, corn**	**potato**	**corn**	**wheat, corn**	**wheat, corn**	**corn**	**corn, potato**	**potato**	**wheat**	**wheat, corn**	**corn**	**corn**
Taxa																
Birds	Acute Oral LD_{50} (mg/kg-bw)	> 2000	17	576	423	11.3	255	>2000	>2000	Unclear	Unclear	0.62	1.44	5.62	3.5	13.2
	Dietary LC_{50} (mg/kg-diet)	> 5000	1536	>5200	>5,040	48	2317	542	>2634	Unclear	Unclear	240	2128	203	191	143
	Repro. NOAEC (mg/kg-diet)	29.7	125	300	205	10	25	5	50	Unclear	Unclear	5	110	25	9	5
Mammals	Acute Oral LD_{50} (mg/kg-bw)	> 5000	424	1563	389	97	45.6	>2000	86	Unclear	Unclear	1.4	1000	60	1.8	0.836
	Repro. NOAEC (mg/kg-diet)	26	250	1000	150	30	50	5	500	Unclear	Unclear	2	240	20	5	1
Honey Bees	Acute Contact LD_{50} (ug/bee)	0.0088	0.043	0.021	0.0275	0.00277	0.17	0.038	0.023	0.037	0.015	0.32	0.20	0.059	No Data	4.09
	Acute Oral LD_{50} (ug/bee)	0.0149	0.0039	0.0038	0.0037	0.00405	1.74	0.483	0.172	0.012	No Data	No Data	0.16	Unclear	No Data	No Data
	Chronic Adult NOAEC (ug/bee)	0.00062	0.00016	No Data	0.00036	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	Unclear	No Data	No Data
	Acute Larval LD_{50} (ug/bee)	> 0.029	No Data	No Data	>15	0.0218	No Data	No Data	No Data	No Data	No Data	No Data	No Data	0.051	No Data	No Data
	Chronic Larval NOAEC (ug/bee)	0.00008	0.0018	No Data	0.680	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	0.001	No Data	No Data
Fish	Acute LD_{50} (ug/L)	251	163	>111,000	>101,500	20	0.06	0.029	0.00475	0.068	0.15	0.36	4.1	0.17	36	0.77
	Chronic NOAEC (ug/L)	11	6.42	1700	9,700	0.039	0.004	0.031	0.000781	0.0042	0.004	0.096	7.4	<0.25	130	0.10
Aquatic Invertebrates	Acute Water Column EC_{50} (ug/L)	0.0215	0.77	35	22	0.056	0.07	0.00008	0.0066	0.0022	0.00397	0.11	0.098	0.0138	0.078	0.17
	Chronic Water Column NOAEC (ug/L)	< 0.0018	0.01	0.74	<0.05	<0.0026	0.0023	0.0002	0.0024	0.00007	0.0013	0.0053	0.06	<0.0046	0.011	0.030
	10-d Benthic NOAEC in µg ai/kg (ug/L-pore water)	14 (0.079)	(0.3)	(35)	(1.1)	9.1 (0.073)	28 (0.13)	0.31 (0.00022)	7.4 (0.0042)	0.53 (0.00012)	0.25 (0.00005)	No Data	No Data	Unclear	(0.91)	No Data
	Chronic Benthic NOAEC in µg ai/kg (ug/L -pore water)	1.5 (0.024)	(0.03)	(>1 [sediment dosed]; 10 [water dosed])	(<0.05)	1.85 (0.015)	21 (0.084)	0.45 (0.00015)	38 (0.024)	<1.4 (<0.00018)	<5.4 (<0.0006)	No Data	No Data	Unclear	(<0.057)	No Data
Terrestrial Plants	Monocot IC_{25}	>0.091	>0.51	>0.28	>0.19	7.1	>0.36	>0.043	No Data	No Data	>0.45	No Data	No Data	>5.7	>0.14	>2.04
	Dicot IC_{25}	>0.091	>0.51	0.28	>0.19	4.62	>0.36	>0.040	No Data	No Data	>0.51	No Data	No Data	2.03	>0.14	>2.04
Aquatic Vascular Plants	IC/EC_{50}	>630	NA	>90,000	>280,000	>100	>4.3	>5.4	>3.2	No Data	>330	No Data	24000	No Data	8800	>4200
Aquatic Non-Vascular Plants	IC/EC_{50}	570	NA	>99,000	17,600	76	>160	>310	>4.4	>181	>290	1300	2040	140	630	>1850

Key

Alternative is less toxic than broflanilide.
Alternative has similar toxicity to broflanilide.
Alternative is more toxic than broflanilide.

Table 2. Comparison of the Toxicity of Broflanilide to other Diamides

	Pesticide:	Broflanilide	Flubendiamide	Cyantraniliprole	Chlorantraniliprole
	PC Code:	283200	027602	090098	090100
	Class:	Diamide	Diamide	Diamide	Diamide
Taxa					
Birds	Acute Oral LD_{50} (mg/kg-bw)	> 2000	>2000	>2250	>2250
	Dietary LC_{50} (mg/kg-diet)	> 5000	>4535	>5620	>5620
	Repro. NOAEC (mg/kg-diet)	29.7	98	1000	120
Mammals	Acute Oral LD_{50} (mg/kg-bw)	> 5000	>5000	>5000	>5000
	Repro. NOAEC (mg/kg-diet)	26	50	200	20,000
Honey Bees	Acute Contact LD_{50}, (ug/bee)	0.0088	>200	1.45	No Data
	Acute Oral LD_{50}, (ug/bee)	0.0149	>200	0.491	No Data
	Chronic Adult NOAEC (ug/bee)	0.00062	No Data	0.10	No Data
	Acute Larval LD_{50} (ug/bee)	> 0.029	No Data	0.0374	No Data
	Chronic Larval NOAEC (ug/bee)	0.00008	No Data	No Data	No Data
Fish	Acute LD_{50} (ug/L)	251	>65.7	>10000	>12,000
	Chronic NOAEC (ug/L)	11	60.5	<750	110
Aquatic	Acute Water Column EC_{50} (ug/L)	0.0215	1.5	20.4	11.6
	Chronic Water Column NOAEC (ug/L)	< 0.0018	0.38	6.56	4.4
	10-d Benthic NOAEC in µg ai/kg (ug/L-pore water)	14 (0.079)	(130)	(719)	No Data
	Chronic Benthic NOAEC in µg ai/kg (ug/L-pore water)	1.5 (0.024)	1.9 (0.28)	10	No Data
Terrestrial Plants	Monocot IC_{25}	>0.091	>0.158	3.56	0.172
	Dicot IC_{25}	>0.091	>0.158	2.28	>0.267
Aquatic Vascular Plants	IC/EC_{50}	>630	>54.6	>12100	>2000
Aquatic Non-Vascular Plants	IC/EC_{50}	570	>69.3	>10000	>1780
Key					

Alternative is less toxic than broflanilide.
Alternative has similar toxicity to broflanilide.
Alternative is more toxic than broflanilide.

Table 3. Comparison of the Environmental Fate Properties of Broflanilide and Alternative Insecticides

Pesticide:	PC Code:	Class:	Half-lives (days)						Mobility
			Hydrolysis @ PH 7.0	Aquatic Photolysis	Aerobic Soil Metabolism	Anaerobic Soil Metabolism	Aerobic Aquatic Metabolism	Anaerobic Aquatic Metabolism	K_F (K_D) or K_{FOC} or K_{OC} (L/kg)
Broflanilide	283200	Diamide	Stable	80	829-5742	157-2354	945-1430	871-1411	*113-248*[A] 3596-20204
Flubendiamide	027602	Diamide	Stable		Stable	Stable	Stable	289	1076-3318
Cyantraniliprole	090098	Diamide	31	0.33	16.2-89.4	4.3	3.9-25.1	2.4-12	157-376
Chlorantraniliprole	090100	Diamide	Stable	33	228-924	Not Measured	125-231	208	152-535
Imidacloprid	129099	Neonicotinoid	Stable	0.2	139-608	Not Measured	30-159	33	98-487
Thiamethoxam	060109	Neonicotinoid	Stable	3.6-3.9	34.3-464	45.6-118.0	16.3-35.1	20.7-28.6	33.1-176.7
Clothianidin	044309	Neonicotinoid	Stable	0.6	148-1155	Not Measured	177.7-182.4	27	84-345
Fipronil	129121	Phenylpyrazole	Stable	0.33	128-308	Not Measured	14.5-35.5	160	427-1248
tefluthrin	128912	Pyrethroid	Stable	Stable	17.37-138-6	>30	66	Not Measured	134,000-520,000
L-Cyhalothrin	128897	Pyrethroid	Stable	30-37	12-102	30-148	21-82	58-6320	110,000-724,000
Zeta cypermethrin	129064	Pyrethroid	Stable	36.2	59.8-60.7	53.3-63.0	8.9-54.9	27.8-70.4	20,800-328,500
cyfluthrin	128831	Pyrethroid	Stable	4.5	39.7-174	30-130	7.71-55.2	9.4-48.3	73,000-180,000
Bifenthrin	128825	Pyrethroid	Stable	49	97-250	2061	87-455	267-9391	131,000-275,000
Phorate	057201	OP	3	Not Measured	65-137	Not Measured	Not Measured	Not Measured	405-705
Malathion	057701	OP	6	98	0.3-7	Not Measured	0.5-10	2.5	151-308
Chlorpyrifos	059101	OP	72	30	11-180	39-51	Not Measured	Not Measured	360-31,000
Tebupirimphos	129086	OP	45	1.3-4.2	123-343	279-Stable	Stable	Stable	12.37-15.63
Terbufos	105001	OP	<2.0	<.2.0	5.8-10.2	67.5	2.6-19.7	Not Measured	*5.4-14.6*[A]

[A] K_F or K_D values are reported because they are more applicable for mobility characterization.