UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON D.C., 20460

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OFFICE OF
PREVENTION, PESTICIDES AND
TOXIC SUBSTANCES

Memorandum:

SUBJECT: BEAD Public Interest Finding for Flubendiamide to Control Lepidoptera Pests on Corn, Cotton, Tobacco, Leafy Vegetables, Fruiting Vegetables, and Vine (DP 348894)

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PRP Review: April 2, 2008

SUMMARY:

BEAD has reviewed the data submission in support of a Public Interest Finding for the proposed uses of flubendiamide on corn (sweet and field), cotton, tobacco, tree fruit, nuts, vegetables (leafy and fruiting), and vine crops and has concluded that registration of this new active ingredient would be in the public interest. However, it should be noted that no efficacy data were submitted for vine crops and BEAD can therefore only assume similar levels of control as noted for the other crops. As a unique new chemistry with a novel mode of action, flubendiamide should play an important role in resistance management and therefore prolong the effective life of currently registered insecticides used to control lepidopterous pests of the aforementioned crops.

BACKGROUND:

Flubendiamide is a new insecticide which specifically targets immature lepidoptera pests. It represents a new class of insecticide, pthalmic acid diamides. Flubendiamide works by activating the ryanodine receptor which regulates muscle and nerve activities by modifying levels of calcium in these cells. Ryanodine receptor activation results in rapid cessation of feeding followed by death and also exhibits residual larvicidal activity. Flubendiamide exhibits no cross-resistance with conventional insecticides and should therefore provide a new tool for management of lepidopteran insecticide resistance.

The registrant (Bayer) is proposing labeling to use flubendiamide on corn, cotton, tobacco, leafy vegetables, fruiting vegetables, and vine crops to control lepidopterous pests. Pests for which flubendiamide is recommended are listed in Table 1.

Table 1. Recommended lepidopterous pests targeted for control with flubendiamide.

Crop	**Lepidopterous Pest**
Corn (field, pop, sweet, and seed)	Armyworms (beet, fall, yellowstriped, and true), black cutworm, corn earworm, corn borer (European and Southwestern), Western bean cutworm
Cotton	Armyworms (beet, fall, yellowstiped, and true), cotton leafworm, looper (cabbage and soybean), and saltmarsh caterpillar
Tobacco	Tobacco budworm, tobacco hornworm
Pome Fruit (apple, crabapple, loquat, mayhaw, pear, oriental pear, and quince)	Codling moth, eyespotted bud moth, fruitworm (green and loconobia), leafroller (obliquebanded, pandemic, redbanded, and variegated), lesser appleworm
Stone Fruit (apricot, sweet cherry, tart cherry, nectarine, peach, Chickasaw plum, damson plum, and Japanese plum, plumcot, and prune)	Green fruitworm, learollers (oblique banded, pandemic, redbanded, and variegated)
Tree nut (almond, beech nut, brazil nut, cashew, chestnut, chinquapin, filbert, hickory nut, macadamia nut, pecan, pistachio, walnut (black and English)	Fall webworm, hickory shuckworm, naval orangeworm, peach twig borer, pecan nut casebearer, walnut caterpillar
Grape (American bunch grape, muscadine grape, and vinifera grape	Cutworm, grape leaffolder, grape leaf skelotonizer, omnivorous leafroller, orange tortrix

The registrant's claims to support a Public Interest Finding fall into three categories: comparative efficacy, resistance management and integrated pest management programs. Bayer's chief arguments center on flubendiamide being a new chemistry with wide efficacy against

Lepidoptera pests which makes it a valuable tool for inclusion in an integrated pest management program for the management of insect resistance. This implies that flubendiamide is not only effective as a stand-alone insecticide but will also extend the effective life of other insecticides on the submitted crops.

COMPARATIVE EFFICACY:

The registrant claims that flubendiamide is efficacious against a wide range of lepidopterous pests and is equivalent in efficacy to the industry standards for control of the target pests. Tables 2–9 provide a synopsis of comparative efficacy studies submitted by the registrant in support of the Public Interest Finding. While the registrant submitted efficacy data over a wide range of flubendiamide application rates, the following table only considers the most effective flubendiamide application rate. Overall, BEAD found that flubendiamide does provide superior or equivalent control to the crop specific standard insecticides across all registrant supported crops. However, comparative efficacy data were not provided for grapes, therefore BEAD assumes similar efficacy as were noted for the other crops. In addition, the registrant submission also indicates that flubendiamide exhibits good residual activity. This efficacy data indicate that flubendiamide could play an important role as a rotational insecticide to prevent or lessen insecticide resistance in the target pest populations.

Table 2. Comparative Efficacy (% control) of Flubendiamide and Alternative Insecticides on corn.

Crop	Pest	Days after application	Flubendiamide	Spinosad	Best Pyrethroid
corn	Fall armyworm	2-8	80%	72%	70%
		10-22	88%	44%	62%
	Black cutworm	1-14	98%	78%	84%
	Corn borer	6-26	98%		88%
	Corn earworm	2-25	73%	73%	66%

Table 3. Comparative Efficacy (% reduction in damage) of Flubendiamide and Alternative Insecticides on cotton.

Crop	Pest	Flubendiamide	Best Pyrethroid
Cotton	Bollworm/budworm	80%	82%
	Beet armworm	81%	81%
	Soybean looper	62%	62%
	Cabbage looper	68%	68%
	Spodotera sp.	100%	n/a

Table 4. Comparative Efficacy (% control) of Flubendiamide and Alternative Insecticides on tobacco.

Crop	Pest	Days after application	Flubendiamide	Best Pyrethroid
Tobacco	Tobacco buworm	4	81%	61%
		11	94%	61%
		46	100%	59%
	Tobacco hornworm	3	90%	83%
		7	86&	63%
		14	89%	73%

Table 5. Comparative Efficacy (% control) of Flubendiamide and Alternative Insecticides on apple.

Crop	Pest	Flubendiamide	Spinosad	Azinphos methyl	methoxyfenozide	Standard[a]
Apple	Oblique band leafroller	92%	70%	88%	82%	
	Codling moth (eastern)	80%				92%
	Codling moth (western)	62%				82%

[a] Standards include: Guthion Calypso and Programs with Actar, Assail, Calypso, Guthion, Intrepid, Rimon, Spintor

Table 6. Comparative Efficacy (% control) of Flubendiamide and Alternative Insecticides on almond and pistachio.

Crop	Pest	Fluben diamid e	Azinphos methyl	Chlorpyrifos
Almond and Pistachio	Navel orangeworm	80%	78%	66%

Table 7. Comparative Efficacy (% control) of Flubendiamide and Alternative Insecticides on brassica.

Crop	Pest	Days after application	Flubendiamide	Spinosad	Indoxicarb	Methoxyfenozide	Best Pyrethroid
Brassica	Diamondback moth	5-8	98%	98%	82%	100%	76%
		12-16	94%	94%			62%
	Imported cabbageworm	5-8	90%	90%	100%	86%	94%
		12-16	92%	80%	30%	84%	34%
	Cabbage looper	5-8	90%	90%	90%	100%	96%
		12-16	92%	82%	74%	88%	100%
	Beet armyworm		100%	100%			50%

Table 8. Comparative Efficacy (% reduction in damage) of Flubendiamide and Alternative Insecticides on tomato.

Crop	Pest	Flubendiamide	Spinosad	Indoxicarb	Emamectin Benzoate or (methoxyfenozide)	Methomyl	Best Pyrethroid
Tomato	Tomato fruitworm	94%	64%	81%	76%	14%	70%
	Beet armyworm	95%	83%	n/a	(93%)	91%	68%

Table 9. Comparative Efficacy (% damaged fruit) of Flubendiamide and Alternative Insecticides on pepper.

Crop	Pest	Flubendiamide	Spinosad	Best Pyrethroid
Pepper	European corn borer	13%	32%	14%

RESISTANCE MANAGEMENT:

According to the registrant, flubendiamide is a novel insecticide from the new chemical class of pthalic acid diamides. Flubendiamide has a mode of action different from currently registered insecticides and exhibits no cross resistance with the standard insecticides currently used to control lepidopterous pests on the proposed target crops (See Tables 2 – 9 for standard insecticides). The availability of a new insecticide with a unique mode of action will be useful to

growers for resistance management purposes particularly for pests known for rapid development of insecticide resistance (e.g. Diamondback moth on brassica). BEAD believes that flubendiamide could play a substantial role in managing insect pesticide resistance.

INTEGRATED PEST MANAGEMENT PROGRAMS:

The registrant submission shows that flubendiamide is a highly selective insecticide. Flubendiamide exhibits low toxicity to beneficial insects (predators and parasites) and honey bees. Flubendiamide has a better toxicity profile than most insecticides currently targeted to control lepidopterous pests in the target crops (e.g. spinosad, indoxicab, emamectin benzoate, methomyl and the synthetic pyrethroids). In addition, due to the selective nature of this insecticide, flubendiamide should not result in the flaring of secondary pest populations. Weighing these factors, BEAD believes that flubendiamide can be a valuable tool in development of integrated pest management programs.

CONCLUSIONS:

As flubendiamide is a novel chemistry, BEAD believes that it can be an important tool as a rotational insecticide to limit or prevent resistance development. As such, flubendiamide can also be expected to extend the useful life of other currently registered insecticides. BEAD's analysis of the submitted material indicates that flubendiamide provides Lepidoptera control equivalent or superior to the insecticides currently being used for pest control in the evaluated crops. Furthermore, the low toxicity to insect predators and honey bees should make flubendiamide an important component in integrated pest management programs.