

# 2021 Guidelines for Diamondback Moth Management in Desert Cole Crops



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These guidelines were prepared in response to the diamondback moth (DBM) outbreaks that occurred in Arizona in fall 2016, and the much lighter populations that have occurred since. The recommendations are based on our field observations and results from numerous lab and field research trials. These guidelines are intended to serve as a reference for PCAs in preparing management programs for the upcoming fall produce season, that includes scouting for DBM and controlling the pest with insecticides. Listed below are recommendations for effectively managing DBM during the fall on transplanted and direct-seeded Cole crops:

- **Communicate with nursery before transplanting**

PCAs and growers should stay in close contact with the nursery facility producing transplants. Before the transplants are delivered to the field, PCAs and growers should ask whether there are any issues with DBM or other pests during production. In addition, it may be important to know what insecticides have been used in the nursery to control insects.

- **Inspect trays prior to transplanting**

Upon arrival to the field, PCAs/growers should inspect several plants from numerous trays for the presence of DBM eggs, larvae, and feeding damage.

- **Verimark transplant drench as a preventative management option.**

Growers should consider having transplants treated with Verimark (cyazypyr) 48-72 before transplanting. Assuming the rate (13.5 oz/ac) is applied correctly to the trays, you should expect about 30+ days of systemic control of DBM, beet armyworm and cabbage looper after transplanting. You should also expect 45-50 days of systemic whitefly control. For resistance management purposes, do not apply Exirel or Minecto Pro (foliar formulations of cyazypyr), Harvanta (cyclaniliprole), or any other diamide insecticide for 60 days following the application of Verimark to minimize selection pressure of the diamide chemistry on both Lep and whiteflies.

- **Scout fields thoroughly for eggs / mines / larvae**

Once plants begin to actively grow following transplanting or when direct seedling crops emerge, scouting for the presence of eggs/larvae/damage is very important (*Figures 1-6*). When eggs are found, mining by 1<sup>st</sup> instar larvae can be anticipated within 3-4 days, and larvae feeding on leaf tissue should be expected thereafter.

- **Understanding DBM Biological Development is Important**

The developmental thresholds for DBM larvae are broader than for other Lep larvae (*Table 1*) and under ideal conditions can complete a generation more rapidly; they can go from egg to adult in 11-12 days. Under unusually warm fall growing conditions (Avg. temperatures ~85 F°) DBM could potentially develop 5 generations before harvest in early planted and transplanted fall crops. This also means that DBM will be more active in December and January than the other Lep species.

- **Crop Sanitation**

During harvest of brassica crops, the crop can often remain untreated for several weeks. This can result in significant development of DBM, particularly with higher temperatures in the spring. However, DBM dispersal from harvested hosts can often be significantly reduced with timely cultural practices following harvest. The longer a harvested crop remains above ground, the more DBM larvae that can develop, pupate and disperse to an adjacent crop. When practical, stress to your growers to disc under recently harvested Cole crop fields ASAP.

- **Initiate foliar insecticide control early.**

Spray timing is important. When DBM larvae begin to show up on fall crops, insecticide sprays should be initiated quickly to prevent DBM from colonizing and establishing on the crop. For Verimark treated transplants, PCAs should be especially careful to monitor crops after 25 days in anticipation of larval activity.

- **Rotate Modes of Action**

Based on extensive testing the last four seasons, PCAs have several effective options from which to control DBM (Table 2). Products most active on larvae (larvicides) include: Radiant, Entrust, Proclaim, Exirel, Harvanta, and Verimark. Products such as Coragen, Besiege, Avaunt, Intrepid and Bt (kurstali and aizawai) are less effective but showed shown significant activity last season. Products with good adult activity (adulticides) include: Lannate, Pyrethroids, and Dibrom. We strongly suggest for resistance management purposes that modes of action be rotated where an alternative product is applied on each subsequent spray to eliminate consecutive uses of the same MOA. We also recommend that larvicides not be tank-mixed but do suggest tank mixing an adulticide with a larvicide when moths are present.

- **Maximize insecticide applications whenever possible**

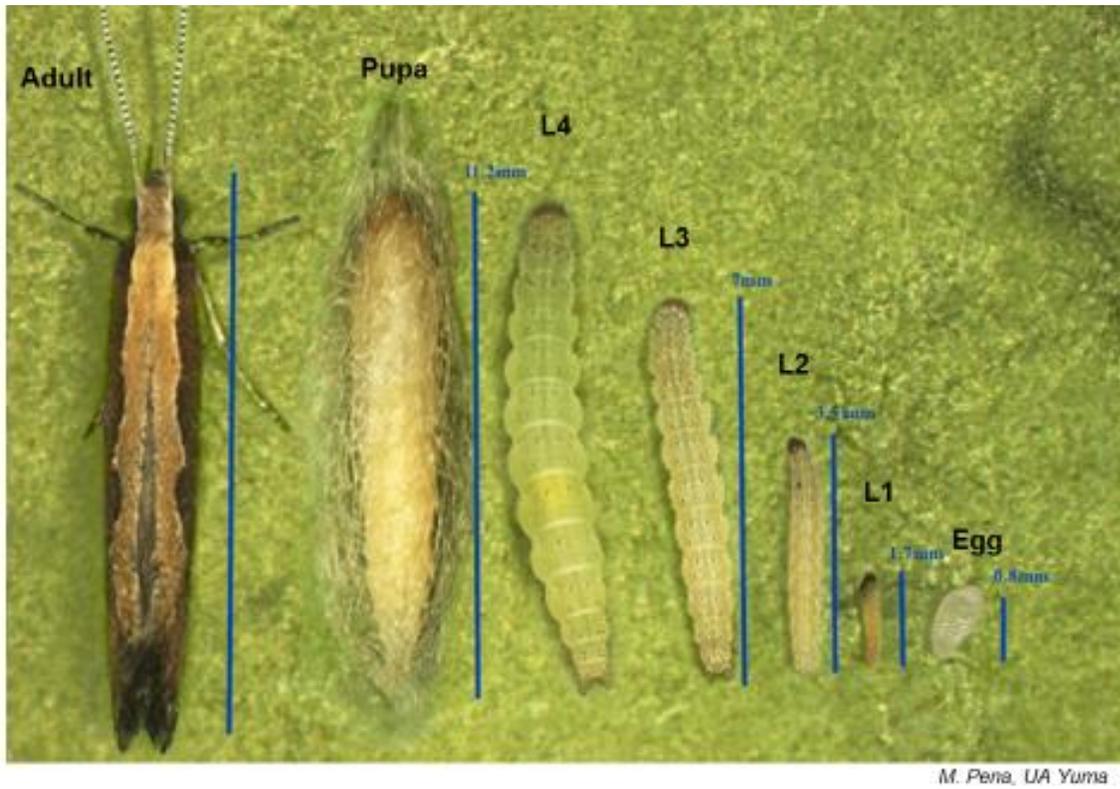
Use only recommended products and rates necessary to accomplish desired control. Whenever possible, apply insecticides by ground sprays to optimize spray deposition and coverage. An adjuvant should always be used with foliar insecticide applications on Cole crops to assist in spray atomization and penetration, and to provide uniform deposition of spray droplets on foliage

- **Be aware of insecticide resistance**

Local research in the fall 2020 showed that DBM populations found on direct seeded brassica crops in the Yuma Valley were susceptible to all standard insecticides (Radiant, Proclaim, Exirel, Harvanta, Avaunt and Coragen/Besiege). However, DBM populations collected in cauliflower fields from Salinas, Santa Maria and Oxnard in 2019 and 2020 show that populations from all three growing areas were resistant to chlorantraniliprole (Coragen, Besiege). The Salinas populations were insensitive to pyrethroid also. It is advised that PCAs avoid use of chlorantraniliprole for DBM control on brassica crops established with transplants originating from coastal California.

**Table 1. Temperature and Developmental Rate for DBM**

Pest	Developmental Threshold (°F)		Optimal Temp for growth (°F)	Egg to Adult (days)
	Lower	Upper		
Cabbage Looper	54	100	86	17-18
<b>Diamondback moth</b>	<b>39</b>	<b>107</b>	<b>86</b>	<b>11.1</b>
Bagrada bug	62	108	95	14-15



**Figure 1.** DBM Life stages; Adults, Pupa, 1<sup>st</sup>-4<sup>th</sup> instar larvae (L1-L4) and Egg.



**Figure 2.** DBM egg on seedling cauliflower plant



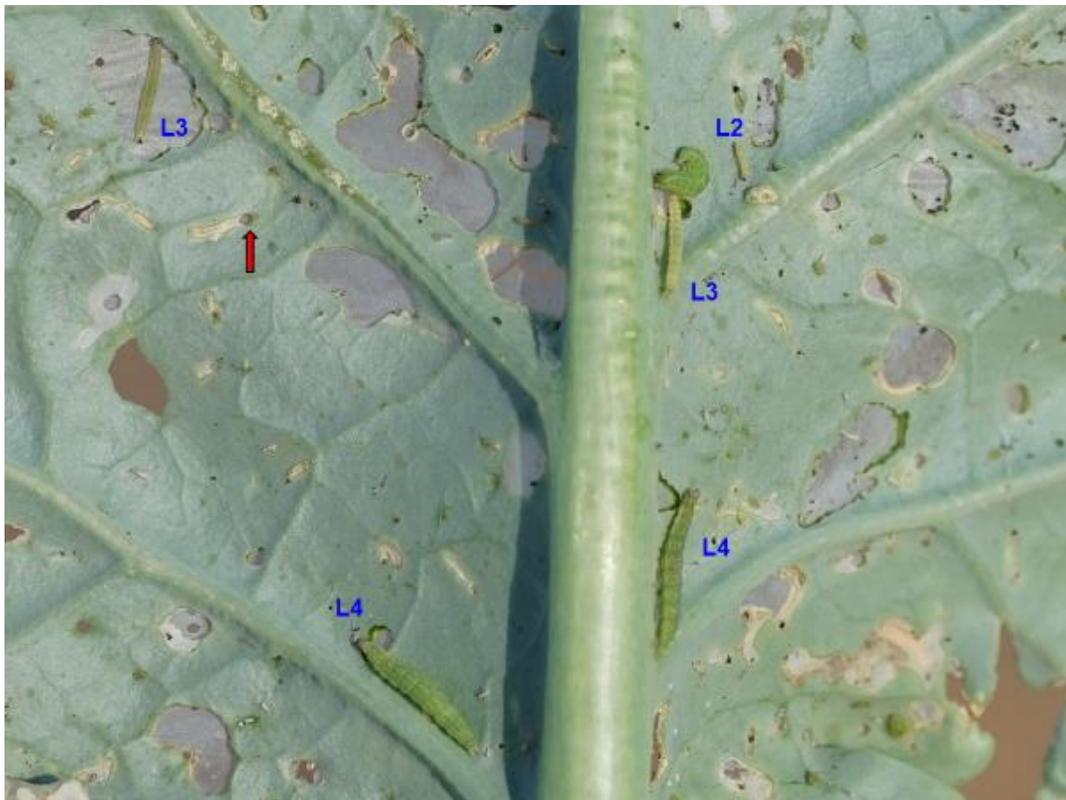
**Figure 3.** DBM eggs on cabbage transplant



**Figure 4.** 1<sup>st</sup> instar DBM larva mining in the leaf tissue in broccoli transplant.



**Figure 5.** Mines and exit holes resulting from feeding by 1<sup>st</sup> instar DBM larvae in broccoli cotyledons.



**Figure 6.** 2<sup>nd</sup> – 4<sup>th</sup> instar larvae and damage on lower side of cauliflower leaf.

**Table 2. Insecticide recommendations for Diamondback moth on desert Cole crops**

Product	IRAC MOA	Relative Efficacy		Comments*
		Larvae	Adults	
Lannate	1A	Good	Good	Provided excellent adult activity via direct contact; larval activity was good in recent field trial. Stay at high rates (~1.0 lbs a.i./ac)
Dibrom	1B	Good	Good	Provided both adult and larval activity in most recent trial. Short residual product. Use at the 2 pints / acre rate.
Malathion	1B	Marginal	Marginal	Based on lab bioassay provides fair adult activity. Did not provide consistent control of larvae in field.
Pyrethroids	3	Marginal	Marginal	Provided good adult and acceptable larval control last few seasons.
Assail	4A	Marginal	Marginal	Listed on label as providing DBM suppression. Research results and PCA survey suggest that Assail is fair on larvae/ marginal against adults.
Radiant/Entrust	5	Good	Marginal	Provided consistent control of larvae last season and had fair to good contact activity against adults in lab bioassays. Use at 5-7 oz rates.
Proclaim	6	Good	Marginal	Provided consistent control of larvae last season and had inconsistent contact activity against adults in lab bioassays. Use at high rates.
Bt (Xentari)	11B	Marginal	Poor	Provided fair-good control of larvae last season at 1.5 lbs. Does not have activity against adults.
Cormoran	15+4A	Marginal	Poor	Provided fair activity against larvae in recent trials and has poor inconsistent activity against adults.
Intrepid	18A	Marginal	Poor	Provided fair-good activity against larvae last year and has no contact activity against adults.
Avaunt	22	Marginal	Poor	Provided fair-good control of larvae last season at 3.5 oz. Have not bioassayed against adults but would not expect activity.
Coragen**	28	**	Poor	Provided good control of larvae last season. Bioassays of populations collected at YAC in fall 2019 and spring 2020 showed they <u>were not</u> resistant to chlorantraniliprole. Bioassays of DBM from Salinas indicate resistance
Besiege	28+3	**	Marginal	Provided good control of larvae last season. Bioassays of populations collected at YAC in fall 2019 and spring 2020 showed they <u>were not</u> resistant to chlorantraniliprole. Bioassays of DBM from Salinas indicate resistance
Exirel	28	Good	Poor	Provided consistent control of larvae last season at 15-20 oz. Did not assay adults but would not expect activity against adults.
Verimark	28	Good	Poor	Provided good residual control of larvae last season when applied as an at-plant shank injection or transplant drench at 13.5 oz/ac.
Harvanta	28	Good	Poor	Provided consistent control of larvae last season at 16.5 oz. Should expect efficacy similar to Exirel.
		Good		<p><b>* Efficacy based on lab bioassays, and field efficacy trials and PCA comments from 2017-20</b></p> <p><b>** Populations of DBM bioassayed from coastal California show high levels of resistance. Be aware of DBM found on transplants originating for the coast.</b></p>
		Marginal		
		Poor		