MVP® II: AN UPDATE ON THE ENCAPSULATED *BACILLUS THURINGIENSIS* (BT) BIOINSECTICIDE

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Abstract

MVP® II Bioinsecticide is produced using the same potent Cry IA (c) delta endotoxin derived from *Bacillus thuringiensis* variety *kurstaki* as MVP. The protein toxin in both products are encapsulated using Mycogen's patented CellCap® encapsulation system. The biological microcapsules protect the biotoxins from environmental degradation resulting in greater foliar persistence than traditional Bt products and more consistent control. One gallon of MVP II contains 1.8 lbs of delta endotoxin of *B. thuringiensis* variety *kurstaki* encapsulated in killed *Pseudomonas fluorescens* as compared to 0.9 lbs for MVP. All other aspects of the formulation are the same. The primary benefit of the concentrate formulation is that there are half the containers to store, transport and dispose of. Field evaluations conducted in 1995 demonstrated that MVP II provides the same effective control of tobacco budworm and cotton bollworm as MVP when used at one half the use rate.

Introduction

Insecticides based on the active ingredient *Bacillus thuringiensis* (*Bt*) have become effective components of many programs designed for control of tobacco budworm and cotton bollworm. The bio-encapsulated product MVP was introduced for use on cotton in the mid-South and Texas in 1993. MVP contains the specially selected CryIA(c) delta endotoxin protein from *Bt* which is the most potent toxin against tobacco budworm and cotton bollworm. The toxin is also active against a wide range of other lepidopteran pests in cotton including loopers.

MVP utilizes the patented CellCap Encapsulation System which helps protect the biotoxins from environmental degradation. Due to this protection of the toxin, MVP provides greater foliar persistence than traditional Bt products which results in more consistent control of caterpillar pests. Also, MVP is more rainfast than conventional *Bt* insecticides.

In 1993 and 1994, 98 large scale demonstration trials were conducted in AR, LA, MO, MS, and TN cotton fields with cotton consultants to compare performance of MVP to conventional *Bt*-based insecticides and chemical insecticides for control of TBW and CB. Results from these trials indicated that MVP provided good early season control of TBW-CB when applied alone at 1.5 to 2.0 pints/acre. Effective control was also achieved when MVP was applied at the rate of 1.5 pints/acre in combination with chemical ovicides or larvicides. Complete descriptions of the trial methods and results are presented in the addendum of the 1995 Proceedings of the Beltwide Cotton Conferences (French, 1995).

Why MVP II?

Lower use rates of agricultural products are desirable for manufacturers, distributor/dealers and growers. The basic benefit is a reduction in the number of containers which must be stored, transported and disposed of. Development of improved analytical and production methods at Mycogen's new state of the art facility in Wisconsin has enabled Mycogen to provide a more concentrate formulation of MVP Bioinsecticide. The product, which is a 2X concentration of MVP, is appropriately named MVP II. One gallon of MVP II contains 1.8 lbs of delta endotoxin of *B. thuringiensis* variety *kurstaki* encapsulated in killed *P. fluorescens* as compared to 0.9 lbs for MVP.

The analytical process being used for determining the active ingredient in MVP II is high performance liquid chromatography (HPLC). This method was developed to directly quantify the amount of toxin in each fermentation batch. Other companies report a.i. based on potency units derived from bioassays which can be variable and confusing. The use of HPLC allows for the precise formulation of product on the basis of toxin and to confirm the concentration of a.i. in the final product, just like other agricultural pesticides.

The second technological advance which allowed for the production of MVP II was the development of a highly efficient fermentation process for producing the *Pseudomonas fluorescens* bacteria used to actually produce and encapsulate the toxin in MVP II. This process was developed over several years and in early 1995, the process was implemented in Mycogen's new fermentation plant in Wisconsin. The implementation of this new process at a manufacturing scale has allowed us to increase yields to a level where we can now produce the more concentrated MVP II product.

There were 2 primary objectives of the field trial program conducted in 1995: 1) to evaluate efficacy of MVP II at 1/2 X use rates of MVP; and 2) expand the experience base for the use of a Bt based product in combination with pyrethroids and organophosphates for control of TBW and CB.

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Materials and Methods

Field trials were conducted in MS, AR, LA and TX. Applications were made by ground and air using commercial equipment and standard application volumes. In most trials conducted, efficacy of MVP II was compared to MVP at 1/2 X use rates. MVP II was used alone or in combination with ovicidal rates of Larvin or Curacron in early season applications. For mid and late season control, MVP II was applied with larvicidal rates of pyrethroids or organophosates. MVP II was generally applied at the rate of 1 pint/acre when used stand alone or .66 to .75 pint/acre when tank mixed with synthetic chemicals also targeted at TBW & CB. In competitive product trials, .66 to .75 pint/acre of MVP II was compared to 1 pint/acre of DiPel®, 1 pint/acre of Condor® and 1/2 lb/acre of Design®, or ratios thereof.

To demonstrate the true benefits provided by adding MVP II to pyrethroids and organophosphates, trials were conducted to compare efficacy of the synthetic chemical alone to efficacy of the synthetic chemical plus MVP II. Consultants selected the trial sites and tank mix partners as well as the method and timing of applications. Selected fields were divided into 2 or more blocks with each being treated identically with the exception of the Bt or chemical treatment. Pre- and post-treatment counts of TBW and CB eggs, larvae and feeding damage were made by the consultants also.

Results and Conclusions

When used alone or in tank mixes with synthetic chemicals for control of TBW and CB, MVP II provided equivalent control to MVP when applied at 1/2 X the use rate (Tables 3 and 8).

In tank mixes with synthetic chemicals, MVP II at the rate of .66 to .75 pint/acre provided as good and often better control of TBW and CB when compared to 1 pint of DiPel, 1 pint of Condor or 1/2 lb of Design. The benefit of adding MVP II or MVP to pyrethroid and organophosate sprays was clearly demonstrated (Tables 4 and 9). These results were very similar to those reported for MVP when used at 2 times the rate of MVP II (French, 1995).

MVP II, a water based formulation, was successfully applied by air and ground with no handling, mixing or application problems. The concentrate formulation will be desirable for distributor/dealers and growers due to a reduction in the number of containers which must be stored, transported and disposed of.

Acknowledgments

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References

French, N. M., II. 1995. Control of Tobacco Budworm in Mid-South Cotton with MVP®, an Encapsulated *Bacillus thuringiensis* (*Bt*) Bioinsecticide, pp. 9-14. *In* Addendum of the 1995 Proceedings Beltwide Cotton Conferences, San Antonio, TX. National Cotton Council of America, Memphis, TN.

Table 1. Control of tobacco budworms and cotton bollworms comparing MVP II and Condor OF plus Larvin. Lecompte, LA. 1995.

Application # 1: 5/30/95

		TBW/CB Counts per 100 terminals			
		Precount		5 DAT	
Treatment	Rate/acre	Eggs	Larvae	Eggs	Larvae
MVP II + Larvin®	.75 pint + 62 pint	**18**	**13**	0	**0**
Condor® Larvin	1 pint+ .62 pint	**18**	**13**	0	**0**

Applications were made by air using 2 GPA. An application went out on 5/30/95 and 0.5" rain fell within 1 hour. The insecticides were reapplied on 5/31/95 and rain again fell approximately 24 hours later. On 5/29, larvae were 1 and 2 days old.

Table 2. Control of tobacco budworms and cotton bollworms comparing MVP II to DiPel ES. Webb, MS. 1995,

Application # 1: 6/9/95

TBW/CB ratio ≅ All TBW

		TBW/CB Counts per 100 terminals			
		Precount		5 DAT	
Treatment	Rate/acre	Eggs	Larvae	Eggs	Larvae
MVP II + Provado® + Vydate®	.75 pint + 3.75 oz + 12 oz	**12**	**1**	16	**2**
DiPel ES + Provado + Vydate	1.0 pint + 3.75 oz 12 oz	**14**	**1**	14	**3**

Application # 1: 6/16/95

TBW/CB ratio ≅ All TBW

		TBW/CB Counts per 100 terminals			
		Precount		4 DAT	
Treatment	Rate/acre	Eggs	Larvae	Eggs	Larvae
MVP II + Provado + Vydate	.75 pint + 3.75 oz + 12 oz	**16**	**2**	2	**0**
DiPel ES +1.0 pint + Provado + Vydate	3.75 oz 12 oz	**14**	**3**	2	**0**

Applications made 6/9 & 6/16 were made by ground using 5 GPA.

Table 3. Control of tobacco budworms and cotton bollworms comparing MVP II and MVP plus Baythroid. Felton, AR. 1995.

Application # 1: 8/6/95

TBW/CB Counts per 100 terminals & squares

TBW/CB ratio ≅ 60/40

		Precount		3 DAT	
Treatment	Rate/acre	Eggs	Larvae	Eggs	Larvae
MVP II + Baythroid®	.75 pint + 2 oz	**76**	**22**	97	**9**
MVP + Baythroid	1.5 pint + 2 oz	**78**	**23**	100	**10**

Application # 2: 8/10/95

TBW/CB counts per 100 terminals & squares

TBW/CB ratio ≅ 50/50

		Precount		4 DAT	
Treatment	Rate/acre	Eggs	Larvae	Eggs	Larvae
MVP II + Baythroid	.75 pint + 2 oz	**97**	**9**	17	**3**
MVP + Baythroid	1.5 pint + 2 oz	**100**	**10**	18	**3**

Application # 3: 8/18/95

TBW/CB counts per 100 terminals & squares

TBW/CB ratio ≅ 20/80

		Precount		4 DAT	
Treatment	Rate/acre	Eggs	Larvae	Eggs	Larvae
MVP II + Baythroid	.75 pint + 2 oz	**116**	**16**	14	**2**
MVP + Baythroid	1.5 pint + 2 oz	**111**	**17**	15	**3**

Applications were made by air using 5 GPA.

Table 4. Control of tobacco budworms and cotton bollworms comparing pyrethroids and an OP with and without MVP II. Benoit, MS. 1995.

Application # 1: 7/18/95

TBW/CB Counts per 100 plants

TBW/CB ratio ≅ 20/80

		Precount		5 DAT	
Treatment	Rate/acre	Eggs	Larvae	Eggs	Larvae
MVP II + Scout X-TRA®	.66 pint + 3.2oz	**20**	**3**	24	**6**
Scout X-TRA	3.2 oz	**25**	**5**	23	**16**

Application # 2: 7/24/95

TBW/CB Counts per 100 plants

TBW/CB ratio ≅ 90/10

		Precount		5 DAT	
Treatment	Rate/acre	Eggs	Larvae	Eggs	Larvae
MVP II + Asana® + Lannate®	.66 pint + 3.2oz 10.7 oz	**24**	**6**	13	**9**
Asana + Lannate	3.2oz 10.7 oz	**23**	**16**	17	**15**

Applications were made by air using 3 GPA.

Table 5. Control of tobacco budworms and cotton bollworms comparing MVP II and Condor plus a pyrethroid. Winnsboro, LA. 1995.

Application # 1: 7/21/95

TBW/CB Counts per 100 terminals & squares

TBW/CB ≅ 30/70

		Precount		5 DAT	
Treatment	Rate/acre	Eggs	Larvae	Eggs	Larvae
MVP II + Fury®	.66 pint + 3.5 oz	**20**	**11**	4	**2**
Condor+ Fury	1 pint + 3.5 oz	**22**	**11**	7	**4**

Applications were made by air using 3 GPA.

Table 6. Control of tobacco budworms and cotton bollworms comparing Fury + MVP II to Fury plus Curacron. Marion, AR 1995.

Application # 1: 7/29/95

TBW/CB Counts per 100 terminals

TBW/CB ratio ≅ 50/50

		Precount		3 DAT	
Treatment	Rate/acre	Eggs	Larvae	Eggs	Larvae
Fury + MVP II	3.8 oz + .66 pint	**40**	**7**	0	**9**
Fury + Curacron®	3.8 oz + .5 pint	**39**	**9**	1	**8**

Applications were made by air using 5 GPA.

Table 7. Control of tobacco budworms and cotton bollworms comparing MVP II and Design plus Curacron. Jonesboro, AR. 1995.

Application # 1: 8/1/95

TBW/CB Counts per 100 terminals

TBW/CB ratio ≅ 30/70

		Precount		5 DAT	
Treatment	Rate/acre	Eggs	Larvae	Eggs	Larvae
MVP II + Curacron	.75 pint + 4 oz	**8**	**6**	1	**3**
Design+ Curacron	.5 lb + 4 oz	**8**	**7**	1	**4**

Applications were made by ground using 10 GPA.

Table 8. Control of tobacco budworms and cotton bollworms comparing MVP II and MVP plus Baythroid. Greenwood, MS 1995.

Application # 1: 8/11/95

TBW/CB Counts per 100 plants

TBW/CB ratio ≅ 60/40

		Precount		3 DAT	
Treatment	Rate/acre	Eggs	Larvae	Eggs	Larvae
MVP II + Baythroid	.66 pint + 2.56 oz	**0**	**24**	4	**4**
MVP + Baythroid	1.32 pint + 2.56 oz	**0**	**20**	0	**4**

Application # 2: 8/20/95

TBW/CB Counts per 100 plants

TBW/CB ratio ≅ 60/40

		Precount		5 DAT	
Treatment	Rate/acre	Eggs	Larvae	Eggs	Larvae
MVP II + Baythroid	.66 pint + 2.56 oz	**44**	**10**	4	**4**
MVP + Baythroid	1.32 pint + 2.56 oz	**48**	**8**	0	**4**

Applications were made by air using 3 GPA.

Table 9. Comparison of Curacron alone and in combination with MVP for control of TBW and BW. Webb, MS. 1995.

Application #3: 8/13/95

TBW/CB Counts per 100 terminals

TBW/CB ratio ≅70/30

		Precount		4 DAT	
Treatment	Rate/acre	Eggs	Larvae	Eggs	Larvae
MVP + Curacron	1.5 pint + 1 pint	**130**$^{+}$	**25**	120^{+}	**6**
Curacron	1 pint	**130**$^{+}$	**25**	120^{+}	**16**

Applications were made by air.