

FORMULATION ALTERNATIVES FOR COMMAND HERBICIDE ON COTTON

**S.J. Stringer, Research Biologist,
West Monroe, LA**

**T.I. Crumby,
Technical Service Representative
Jackson MS**

**J.L. Taylor, Technical Service Representative
Southaven, MS
FMC Agricultural Products Group**

Abstract

Development of an alternative microencapsulated formulation of Command for use by cotton growers to reduce the potential for off-target movement of clomazone has been a priority and ongoing research and development program. A pilot commercial formulation, Command 2ME, was available to cotton growers in 1995. The use of this formulation by cotton growers in commercial situations demonstrated that the potential for off-target clomazone movement was substantially reduced in comparison to Command 4EC. The weed control obtained with this formulation was comparable to Command 4EC. However, problems associated with mixing and application suggested that this formulation was not of commercial quality. Continued research has developed new Command 3ME formulations which have been evaluated in small-plot university and company trials, and in commercial situations. These formulations have proven to provide reductions in the potential for off-target movement equal to or greater than Command 4EC applied pre-plant incorporated. Weed control studies have confirmed that performance is also equivalent to that obtained from Command 4EC. Mixing and sprayability studies have demonstrated that the Command 3ME formulation is of superior commercial quality. Command 3ME will be commercially available to cotton growers in 1996.

Introduction

The movement of clomazone from application sites to adjacent (off-target) sites is a known potential with this compound. Because clomazone inhibits development of carotenoid and chlorophyll pigments, the occurrence of discoloration of the leaves of susceptible non-target plant species can result in visual symptomology of off-target movement. However, symptoms of off-target movement of clomazone following Command 4EC application occurs on only a small percentage of commercially treated sites. Although the discoloration of plants adjacent to clomazone treated areas is generally short-lived, it can occasionally be a cause of concern. Current formulation technology has provided techniques for microencapsulation of compounds

which restricts the rate at which they are released and become available in the environment.

During the last several years, the FMC Corp. Ag. Products Group has conducted ongoing research into the development of microencapsulated formulations of clomazone. Replicated small-plot field studies conducted in 1994 provided evidence that Command 2ME was effective in reducing off-target movement of clomazone and was as effective as Command 4EC in providing weed control in cotton. While advancing this formulation to a pilot commercial status in 1995, efforts toward development of a commercial Command 3ME formulation were continued and intensified. This paper reports results of commercial demonstration and small-plot studies on microencapsulated Command formulation off-target movement reduction and efficacy and phytotoxicity in cotton.

Materials and Methods

Command 2ME

Studies on the reduction of off-target movement were conducted in large-plot demonstration trials with a pilot commercial microencapsulated Command formulation (Command 2ME) in grower fields in 1995. Treatments evaluated included Command 4EC (broadcast, PPI), Command 4EC (banded, pre), Command 2ME (broadcast, PRE) and Command 2ME (banded, PRE). All treatments were applied in tank mixtures with commonly utilized fluometuron formulations. A total of ten trials were conducted in AR, AL, LA, MO, MS, NC, and TN. All treatments were applied by farmers in actual commercial use situations with fields being separated by at least one-half mile but no more than five miles. Data were collected on the average maximum severity of vegetation discoloration (Rating scale: 0 = no symptoms, 1 = <10%, 2 = 10-20%, 3 = 20-50%, and 4 = >50%) maximum distance (ft.) of off-target movement on native surrounding vegetation at 7, 14, 21 and 28 days after treatment. Additional survey data were collected from other commercial Command 2ME (broadcast or banded, PRE) application sites to compare against Command 4EC (broadcast PPI or banded Pre) for formulation handling (pouring, mixing, nozzle clogging, tank residue), efficacy, discoloration intensity, maximum distance of discolored vegetation (discoloration, distance), and time required for affected surrounding vegetation to recover from clomazone induced leaf discoloration (green-up).

Command 3ME

Studies on the reduction of off-target movement in sunflowers with 3ME Command formulations were conducted in seven small-plot trials in 1995. Three microencapsulated clomazone formulations, F5080 3ME, F5160 2ME and F5320 3ME, all surface applied broadcast (PRE), were selected for testing. Included for comparison were Command 4EC applied both PRE and PPI. All materials were applied at 1.0 lb. ai/a. In order to accomplish a geographical distribution and associated

variations in environmental conditions representative for clomazone usage, test sites were located in the following states: WI, VA, LA, NC, TN, MS, and MN.

Previous research on the susceptibility of agronomic crops to leaf discoloration resulting from off-target clomazone movement has shown sunflowers to be among the more sensitive species. Oil-type sunflowers were used in these studies as the indicator species of off-target movement.

The study designs were RCB with three replications. Three acre blocks of sunflowers were narrow-rowed or broadcast drilled in the test sites. Treatments were applied to 10' X 10' bare ground plots when sunflowers in surrounding 40' buffers between plots had reached the 2 - 6 leaf stage. Prerequisite conditions for the application were that the soil be moist, but not saturated, at the time of application to facilitate off-target clomazone movement. Applications were made during periods of minimal air movement and with shielded sprayers to minimize physical drift. Applications were made with CO₂ propelled backpack sprayers operating at 20 - 30 psi and with a gallonage of 10 - 15 GPA. For PPI treatments, incorporation was mechanical and conducted at depths of 1 - 2 inches. Evaluations were made on 1) maximum distance (ft.) of evidence of sunflower chlorosis and 2) discoloration (percent of green tissues chlorotic) at 1/2 the maximum off-target movement distance were made at 10 - 14 days after the first significant rainfall event. Measurements were taken from the edge of each treated plot in each radii of the eight major compass directions.

Twenty small plot trials were conducted both in-house and in university cotton weed management efficacy and phytotoxicity programs. The study design for these studies was RCB with four replications. These trials compared the efficacy of three microencapsulated Command formulations, F5080 3ME, F5160 2ME, and F5320 3ME to Command 4EC, all applied PRE at 0.88 lb. ai/a and in tank mixtures with fluometuron applied at 0.75 lb. ai/a. Trial locations included AL, AR, LA, MO, MS, NC, TN, and TX. All materials were applied with CO₂ propelled backpack sprayers equipped with flat fan nozzles at a gallonage of 15 - 20 GPA.

Results and Discussion

Command 2ME

The maximum distance at which off-target clomazone movement could be detected was initially greatest at 7 - 21 DAT with Command 4EC (banded PRE), and initially lowest with Command 4EC (broadcast PPI), (Figure 1). However, by 28 DAT, the latter of the two resulted in the greatest movement. Ultimately, the maximum distance of off-target movement detected from either of the Command 2ME treatments was less than half that of the two broadcast PPI and banded PRE Command 4EC treatments. These results conclusively documented that a microencapsulated

Command formulation could effectively reduce off-target clomazone movement when applied in commercial situations. These results also demonstrated that the reduction in off-target clomazone movement provided by microencapsulated formulations could reduce the distance of buffer zones currently required when applying Command 4EC to cotton.

The average intensity of leaf discoloration in affected vegetation was greatest for all treatments at 21 DAT, and lowest at 28 DAT (Figure 2). The most intense leaf discoloration occurred after application of Command 4EC applied banded PRE followed by broadcast PPI. Conversely, the lowest overall leaf discoloration occurred following applications of Command 2ME applied banded PRE or broadcast PRE, respectively. The most striking contrast among these treatments is that the 2ME formulation applied either banded or broadcast PRE resulted in less than or equal discoloration in comparison to Command 4EC broadcast PPI. In commercial field situations, these results demonstrated the effectiveness of a microencapsulated Command formulation in reducing the intensity of leaf discoloration resulting from off-target clomazone movement.

Results of the grower response survey providing commercial usage information comparing Command 2ME to Command 4EC are presented in Table 1. Growers indicated satisfaction with important issues including weed control, reduction in distance of movement and intensity of discoloration on surrounding vegetation, and a reduction in the time needed for affected vegetation to return to normal leaf color. However, grower response to issues on product handling including mixing, nozzle plugging and spray-tank residue indicated that the 2ME formulation was not a suitable commercial formulation.

Command 3ME

Results of observations on average maximum distance of detectable off-target clomazone symptoms in sunflowers taken at 10 - 14 days after the first significant rainfall event are presented in Figure 3. These results documented that the experimental Command 3ME broadcast PRE treatments were as effective as Command 4EC broadcast PPI in reducing the distance off-target clomazone movement. A summary of the incidence of statistically significant reductions in the average maximum distance of off-target clomazone movement is presented in Table 2. When all treatments were compared to Command 4EC broadcast PRE, the experimental formulations applied broadcast PRE had an equal or greater frequency in the number of sites with statistically significant reductions in movement distance than Command 4EC broadcast PPI.

Observations on the average percent reduction in leaf discoloration symptoms in sunflowers, also taken at 10 - 14 days following the first significant rainfall event were taken in six studies and results are presented in Figure 4. These

results again demonstrated that the experimental Command ME formulations were at least as effective as Command 4EC broadcast PPI in reducing the intensity of discoloration of vegetation affected by off-target clomazone movement. Frequencies of trials in which the Command 3ME broadcast PRE treatments provided statistically significant reductions in leaf discoloration were comparable to that obtained with Command 4EC broadcast PPI when compared to Command 4EC broadcast PRE (Table 2).

Results of weed management studies providing data on efficacy and cotton phytotoxicity are presented in Table 3. Observations on percent seedling discoloration taken at 30 days after planting indicated equal or greater crop safety with the experimental Command ME formulations in comparison to Command 4EC. In all, efficacy data was obtained on 30 weed species across all twenty trials. Observations on efficacy against several of the more commonly occurring weeds of Mid-South, Southeast and Southwestern cotton demonstrate that the experimental formulations are as effective as Command 4EC in controlling commonly occurring weeds of cotton.

In the small-plot efficacy trials, no incidences of handling or application problems were reported. The experimental Command 3ME formulations have been further refined, and ongoing investigations on mixing and sprayability with numerous tank mix partners indicate that the current formulation has exceptionally high performance in these areas.

A commercially proven Command 3ME formulation will be available to cotton growers in 1996. This will provide growers with a mechanism to obtain the same unsurpassed weed control that they have enjoyed with Command 4EC with the benefit of a marked reduction in the potential for off-target movement.

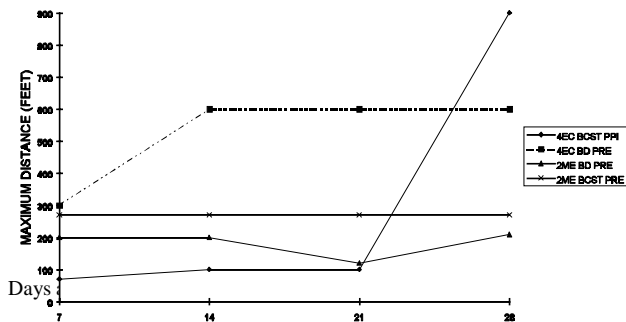


Figure 1. Maximum distance of off-target movement with Command formulations and application method (Mean of 10 large-plot demonstration trials).

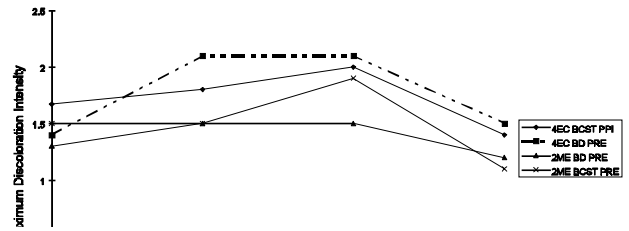


Figure 2. Off target leaf discoloration with Command formulation and application method (Mean of 10 large plot demonstration trials).

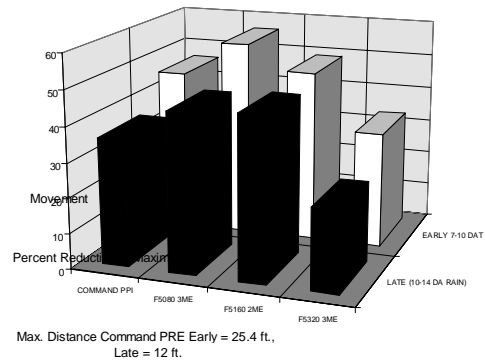
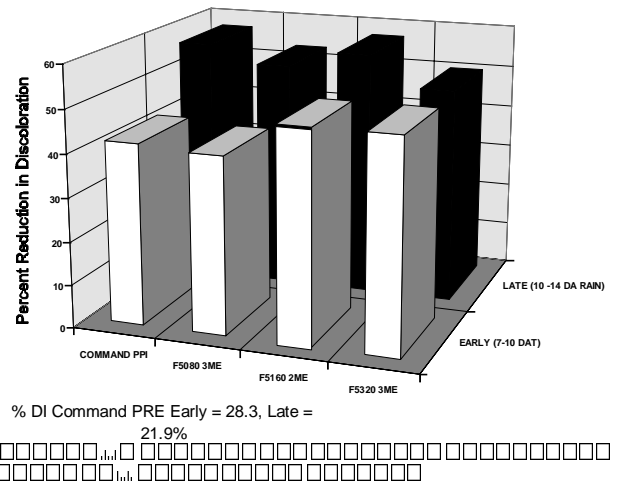


Figure 3. Command Formulation Volatility Studies, 1995. (Mean of 8 Replicated Trials)



% DI Command PRE Early = 28.3, Late = 21.9%

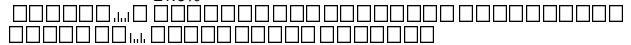


Table 1. Commercial Use Survey : Command 2ME VS Command 4EC

Topic	Response		
	Better	Equal	Worse
Pouring	0	31	5
Mixing (Compatibility)	0	16	19
Nozzle Plugging	1	6	23
Tank Residue	0	24	12
O-T Discoloration Intensity	29	4	0
O-T Discoloration (Distance)	29	12	0
Green-up (Time Interval)	16	12	0

Table 2. Frequency of Statistically Significant Differences between Command 4EC (PRE) and Experimental Formulations

Treatment	Maximum Distance		Percent Discoloration	
	Early	Late	Early	Late
Command 4EC (PPI)	7.*	5	4	5
F5080 3ME (PRE)	8	6	4	5
F5160 2ME (PRE)	7	6	4	4
F5320 3ME (PRE)	6	4	3	2
Total Number of Trials	8	7	7	6

* Number of trials in which the formulation or treatment was significantly lower than Command 4EC (PRE).

Table 3. Command ME Formulation Efficacy / Phytotoxicity Studies

SPP.	Command**	% Control 30 DAE*			No. Obs.
		F5080 3ME	F5320 3ME	F5160 2ME	
BRAPP	94	100	100	100	2
DIGSA	98	98	97	97	4
PANTE	97	99	97	98	2
ABUTH	98	98	98	98	3
SIDSP	91	84	92	90	3
IPOHE	91	87	90	87	4
IPOLA	90	85	89	84	6
DI***	8.0	2.4	5.6	3.8	20

* Efficacy data were obtained on 30 species across all trials.

** All applications were made with Clomazone (0.88 lb. ai/a) and Fluometuron (0.75 lb. ai/a).

*** Percent seedling discoloration at 30 DAE.