SR-EBDC

D-15556

1-25-94 TPP

Ref #7

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

January 25, 1994

MEMORANDUM

OFFICE OF
PREVENTION, PESTICIDES AND
TOXIC SUBSTANCES

SUBJECT: Maneb (014505) on Collards (Greens)
Field Trials, Residue Decline Studies, Reduction of Residue Study
Final Report dated 11/11/93 - TN Field Trials
Final Report dated 11/11/93 - GA Field Trials
[MRID Nos. 43046401, 43046402; CB Nos. 12833 and 12874; DP Barcode D196825]

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Leafy green growers and processors have submitted two residue studies, conducted in TN (MRID 43046401) and GA (MRID 43046402), each of which is actually three studies in one. Each study includes field trials for collards (to be representative of the other leafy greens, turnip greens and mustard greens), a residue decline study, and a reduction of residue study. The studies were submitted in connection with the growers' request for a hearing on the cancellation of maneb on leafy greens (collards, mustard greens, and turnip greens). Design of these studies has been discussed in several memos, meetings, and telephone calls, the most recent of which was a teleconference on 3/25/93. A six month freezer storage stability study was conducted.

Conclusions

1. The submitted study is valid, and was conducted under GLP, with some deviations that do not affect the integrity of the study.

2. The proposed use is 5 applications at the rate of 1.6 lb ai/A. The desired PHI is apparently 10 days.

3. Appropriate analytical methods were used for the study. The same analytical methods for maneb and ETU were used for the EBDC/ETU Market Basket Survey in 1990.

14505

4. A frozen storage stability study was included, with data through 6 months of frozen storage. The samples in the present study were stored up to 6 months. In addition, weathered samples from the study were reanalyzed 9 and 10 months after the initial analysis, with similar results.

5. A rational explanation was provided for ignoring the previously conducted field trial data on kale and mustard greens, and replacing the results with the data included in this submission. The six field trials conducted in GA and TN can be used in lieu of previously conducted field trials in the SE US. In the absence of new field trial data from other parts of the country, previously conducted field studies remain the best available data for dietary exposure and risk assessment for the rest of the US.

6. A residue decline study was conducted. Residues of maneb were found to be PHI dependent and decline with time. Residues of ETU increased initially in most of the trials, and then declined with increasing PHI.

7. Residue levels of maneb reported in collards at the desired 10 day PHI were close to the current tolerance level of 10 ppm. Residues of maneb ranged from 1.2 to 7 ppm in the 6 field trials. If a decision were made to retain or reinstate registration of maneb on collards, mustard, and/or turnip greens in the Southeastern US, the 10 ppm tolerance would still be needed.

8. Average residues found in the 6 field trials in GA and TN were 3.37 ppm maneb and 0.191 ppm ETU.

9. "Fresh Market Processing" was studied. Collards were followed from harvest to the supermarket with residues determined at various points in the process. Residues of both maneb and ETU declined somewhat during "fresh market processing." Average "fresh market processing" factors were found to be 0.75x for maneb and 0.7x for ETU.

10. Commercial processing was studied. Collards were followed from harvest through the commercial processing to produce frozen collards (includes blanching). Residues of both maneb and ETU decreased during this processing. Average processing factors were determined to be 0.11x for maneb and 0.46x for ETU.

11. The currently submitted data can be used along with other available data for estimating dietary exposure and for dietary risk assessment.

12. Based on this study and other available data, we can estimate residues of maneb and ETU in collards cooked from fresh and from frozen collards grown in the southeastern US. These residue estimates can be translated to the other leafy greens (kale, mustard and turnip greens), and weighted for the percentage of greens being processed (3.6% for collards, 10.5% for turnip greens, 7.1% for mustard greens). To use these estimates for turnip greens, there must be a realistic mechanism

to limit use of maneb to turnips grown for greens only. This would require input from BEAD.

Residue Estimates of Maneb and ETU in Raw and Cooked Collards (ppm)

	Maneb	ETU		
Collards at harvest	3.37	0.19		
Collards, raw, washed	0.76	0.05		
Collards cooked from fresh	0.025	0.20		
Collards cooked from frozen	0.004	0.24		
Collards weighted average	0.025	0.20	3.6%	Processed
Turnip green weighted average	0.023	0.20	10.5%	Processed
Mustard green weighted average	0.024	0.20	7.1%	Processed

RECOMMENDATIONS

We recommend that a dietary risk analysis be conducted using these residue estimates. We recommend that BEAD be consulted on the practicality of limiting use on turnips to turnips grown for greens only.

Detailed Considerations

Use pattern

No proposed label was included in the submission. The draft report states that the desired use pattern is use of Maneb Plus Zinc F4 at 1.6 lb ai/A. Five applications would be made at 7 day intervals. The 10 day PHI is apparently preferred. In this study, samples were harvested 0, 1, 2, 5, 10, and 17 days after the fifth application. Trials were conducted in 2 locations in TN and 2 locations in GA. Data from TN and GA were included in separate reports.

Samples from one TN and one GA location were followed through the processing plant, with samples collected at various steps in the processing procedure. Samples from the second TN and GA locations were followed through fresh marketing channels to a retail store, with samples collected at various steps in the channels of trade.

The report indicates that greens are grown throughout the US, but the greens in the southeast (GA, NC, SC, and TN) are particularly susceptible to diseases that maneb will control. During the EBDC Special Review, several

commenters stated that a much lower rate than the 2.4 lb ai/A rate allowed at the beginning of the Special Review or longer PHI than the 10 day PHI registered would be acceptable. This draft report included in this submission indicates that the 1.6 lb ai/A rate with a 10 day PHI is needed.

Collards are normally harvested 75-90 days after planting when they reach full size, but before they become tough and woody (at bolting). The spring crop is planted in March and April for harvest in May and June. The fall crop is planted in June and July for harvest in October and November.

Analytical Methods

McKenzie Laboratory Method PRM-005 was used for maneb analyses (LOQ = 0.02 ppm). This method is McKenzie's modification of Morse Laboratory method ETI-89AM-001, which was used for the EBDC/ETU Market Basket Survey. The sample is reacted with stannous chloride/HCl using heat. Quantitation is by GC with flame photometric detector (FPD) in sulfur mode. Sample calculations were included. Method recoveries were determined during method validation and concurrently with the analytical samples, and were reported as follows.

Maneb Recoveries in Collards

Commodity	N	% Recovery	Fortification Range (ppm)
during method validation	8	90% ± 11%	0.02 - 0.2
concurrent recoveries	26	88% ± 12%	0.02 - 50

McKenzie Laboratory Method PRM-006 was used for ETU analyses (LOQ = 0.01 ppm). This method is a modification of Morse Laboratory Method MTF-88AM-004, which was used for the EBDC/ETU Market Basket Survey. The sample is extracted with water/ethanol, cleaned up with alumina, and analyzed by HPLC using a mobile phase of water:phosphoric acid:acetonitrile and an electrochemical detector with a graphitized carbon electrode. Sample calculations were included. Method recoveries were determined during method validation and concurrently with the analytical samples, and were reported as follows.

ETU Recoveries in Collards

Commodity	N	% Recovery	Fortification Range (ppm)
during method validation	8	85% ± 8%	0.01 - 0.5
concurrent recoveries	27	86% ± 14%	0.01 - 5.0

Storage Stability Data

A six months storage stability study was conducted. Control collard samples were spiked with either 1 ppm maneb or 0.5 ppm ETU. The spiked samples were reanalyzed after 0, 0.5, 1, and 6 months of frozen storage. Conversion of maneb to ETU during frozen storage was not measured. Maneb and ETU were reportedly stable after one month of frozen storage at McKenzie Laboratories. Recovery of maneb was 78% at day 0 and 71%, 71%, and 76% after 0.5, 1, and 6 months of storage, respectively. ETU recovery in frozen storage was 85% at day 0, 80%, 85%, and 14% after 0.5, 1, and 6 months of storage, respectively. The 1987 study at Morse Laboratories also included a study of conversion of maneb to ETU during frozen storage, by analyzing the

maneb fortified samples for ETU. The conversion rate was measured to be less than 2%.

"Weathered" samples (samples with incurred residues) from the collard study were reanalyzed 9 or 10 months after the initial analysis (done 1.5 to 2 months after sample collection), with ETU results 11% and 7% higher than the original analysis. The study authors concluded that there was no loss of ETU in frozen storage, and that the apparent loss in the frozen storage stability study where samples were fortified with ETU was due to exposure of ETU to reactive cell constituents from the grinding of the samples needed to facilitate fortification for the storage stability study. We note that another explanation for the apparent stability of ETU in weathered samples is conversion of EBDC to ETU during frozen storage. If the maneb in the weathered samples converted to ETU, even at only 2% (2% of 2 ppm maneb = 0.04 ppm ETU; a decrease in maneb residue unmeasurable due to analytical variability), enough ETU would be produced to mask a 50% loss of ETU (50% of 0.08 ppm). In order to accurately measure storage stability of ETU residues in crop samples, the crop would need to be treated with ETU (without maneb), weathered in the field until normal harvest time, analyzed on the day of sample collection, and again after frozen storage.

Previously submitted storage stability data are available for frozen storage of lettuce samples at McKenzie Laboratories in 1990 and Morse Laboratories in 1987, and another laboratory in 1986. See Maneb Update of 8/11/92 and M. Kovacs Review of 1/21/87 (RCB No. 1703) for reviews. The following results were reported by Morse Laboratories in 1987 and McKenzie Laboratories in 1990. Ground samples were fortified with either maneb or ETU. Maneb was stable in frozen storage for the 4 or 6 months tested. ETU recoveries in 1987 (Morse Laboratories) were 113%, 107%, and 55% following 0, 1, 3, and 6 months of frozen storage; and in 1990 (McKenzie Laboratories) were 101%, 92%, 65%, and 21% following 0, 1, 2, and 4 months of frozen storage.

Field trial samples from TN (PHIs 0-17 days) were stored 1.5 to 6 months before analysis. The field trial samples from TN harvested 10 days after application were analyzed 1.5 months after sample collection. The field trial samples from GA harvested 10 days after application were analyzed 3 months after sample collection. Commercially processed (frozen) samples from TN were stored 2.5 to 6-6.5 months before analysis. Fresh Market Processed Collards from TN were stored 1.5 months before analysis. Commercially processed (frozen) samples from GA were stored 4 months before analysis. Fresh Market Processed Collards from GA were stored 1.5 months before analysis. Analytical samples were stored at McKenzie Laboratories at -15 F on-site and -19 to +10 F off-site. Temperatures were reported for a freezer at a field office of -30 to -14 C or -22 to +7F. Freezer temperatures at the Pictsweet Frozen Foods Warehouse were -4 to +6 F, and at the Southern Frozen Foods Warehouse, -6 to +2 F.

We conclude that no corrections are needed for losses in frozen storage, because maneb is stable in frozen storage for the 6 months that the samples were stored prior to analysis, and the weathered samples showed similar amounts of ETU after frozen storage.

Residue Field Trials

Originally, the Agency suggested that additional field trials were unnecessary. Since the Agency already had kale residue data at 1.2 and 1.6 lb ai/A, 4 applications, and 7 and 10 day PHIs, and washing, cooking, and commercial processing data, the missing piece of information was what happens to the residue level between harvest and receipt by the processor or consumer. We stated that a reduction of residue study was needed, following the leafy greens from harvest to the market place or the processor.

Earlier field trial studies had shown over-tolerance residues on kale and mustard greens. The trials on kale were conducted in 1987 at 1.2 and 1.6 lb ai/A. The trials on mustard greens were conducted in 1986 at 2.4 lb ai/A. The trials on mustard greens were considered inadequate because of storage stability problems (which would suggest that residues were actually even higher than those measured). Additionally, FDA and the states monitor for EBDC residues in leafy greens and consistently found over-tolerance residues on leafy greens.

We previously indicated that for tolerance setting purposes, a full set of residue data would be needed at the proposed maximum rate, maximum number of applications, and minimum PHI, including trials from several locations in each major growing region. Collards could be considered as a representative crop for the purpose of collecting residue data, if the commodities for which registration is sought include only collards, mustard greens, and turnip greens, and there is a mechanism for limiting use on turnips to turnips grown for greens production only. Collards could also represent kale for residue data purposes. Input from BEAD is needed to determine if there is a practical mechanism for limiting use on turnips to turnips grown for greens production only.

The current submission suggests that the results from the earlier field trial studies overestimated residuees for several reasons: (1) the trials were conducted during a period of little rainfall which would result in higher than normal residues, and (2) the trials were conducted without regard for marketability of the crop using small plots and harvesting at the bolting stage when the greens (leaves) are no longer actively growing and become bitter. No explanation was offered for the consistently high percentage of enforcement samples both from FDA and the States showing over-tolerance residues of maneb on leafy greens.

Field Trials/Residue Decline Study

The TN field trials were conducted using Maneb Plus Zinc F4 at 1.73 - 1.78 lb ai/A. Five applications were made at 7 day intervals. Samples were collected 1, 2, 5, 10, and 17 days after the last application. In a different place in the summary report, the rate was stated to be 1.6 lb ai/A. The tables in the report indicate that the actual rate used was 1.73-1.79 lb ai/A. The trials were conducted on one acre plots. Both plots were irrigated. Rainfall, irrigation, temperature, and relative humidity data were provided. Plant samples on the day of application were collected by cutting the plant at the base with a knife. Leaves were placed in polyethylene bags and

immediately into a cooler with dry ice. On the other sampling days, 3-4 leaves of one collard plant were taken from each subsection of the test plot and composited as one sample. The samples were transferred the same day to a warehouse freezer at Pictsweet frozen foods. Samples were shipped to McKenzie Laboratories frozen. Some of the samples arrived at the laboratory "mushy."

For fresh market samples, a portion of the plot was harvested. For processing samples, the rest of the plots were harvested at a 10 day PHI and processed according to normal procedure. The report does not indicate how any collards were left to be harvested at a 17 day PHI.

RESULTS. The results of the residue decline study are presented in Table 1. Apparent maneb residues in control samples averaged 0.038 ppm and ranged up to 0.061 ppm. Most controls had non-detectable ETU residues, but some control samples had apparent ETU residues as high as 0.074 ppm. Using these data, average and maximum residues can be estimated for different PHIs.

TABLE 1.

MANEB DECLINE STUDY IN COLLARDS
Residue levels of Maneb and ETU at harvest

PHI(days)	Residues (ppm) Maneb	ETU
Plot TA1-TN		
0	23.56	1.672
1	17.68	2.922
2	11.71	1.114
5	3.131	0.204
10	1.140	0.091
17	0.480	<0.01
Plot TA2-TN		
0	39.63	1.964
1	17.02	3.128
2	9.50	1.010
5	3.284	0.165
10	1.382	0.082
17	0.667	0.017
Plot TB1-TN		
0	27.89	1.512
1	15.64	1.356
2	6.53	0.631
5	5.38	0.302
10	2.25	0.123
17	2.41	0.150

MANEB DECLINE STUDY IN COLLARDS
Residue levels of Maneb and ETU at harvest

PHI(days)	Residues (ppm) Maneb	ETU
Plot TA1-GA		
0	35.39	2.127
1	22.87	1.536
2	30.59	1.286
5	14.28	0.716
10	4.960	0.172
17	0.497	0.061
Plot TA2-GA		
0	34.77	1.769
1	20.87	0.868
2	29.62	1.816
5	9.223	0.672
10	3.363	0.284
17	0.412	0.060
Plot TB1-GA		
0	31.57	1.996
1	102.01	5.461
2	39.75	2.096
5	14.15	1.088
10	7.12	0.296
17	0.72	0.076

The average residue reported for a 10 day PHI was 3.37 ppm maneb and 0.191 ppm ETU.

Reduction of Residue Study

During protocol development, we suggested that samples should be collected at different points in the harvest and transportation process, along with sufficient documentation to convince us that the harvest and transportation practices used in the study are universally accepted. The following possible sampling points were suggested, based on presentations by the growers and processors.

1- whole plant which could be harvested (same as rac for residue field trial)
2- part of plant actually harvested
3- plant after hydrocooling
4- plant after transportation to grocery store
5- plant after misting in grocery store

We suggested that samples be collected at each point in the process for several reasons. First, if residues decline to non-detectable at any point in the process, this can be taken into consideration. Second, a pattern of residue decline should be evident. Third, if documentation is not provided that the practices represented are universally accepted, one sampling point could be disregarded without compromising the entire study. Several studies in diverse growing areas would provide this type of information. Duplicate or triplicate samples are usually collected, with analysis also in duplicate or triplicate. We planned to estimate residue reductions for consumer washing and cooking using existing washing and cooking data. We also noted that there would be no guarantee that if these data were provided, that the dietary risk estimated from EBDC use on collard, mustard, and turnip greens would be considered acceptable.

Information from BEAD (P. Lewis, FAX, 6/7/93) indicates that 3.6% of collards grown in GA are processed (96.7% sent to fresh market), 10.5% of turnip greens are processed, and 7.1% of mustard greens are processed. We will assume that the percentage of greens being processed is the same throughout the SE US.

Handling of Fresh Market Collards. Collards destined for fresh market were sampled at the following stages:

1 after transport to the fresh market facility
2 after washing in a hydrocooler
3 after storage prior to moving to a grocery store display
4 after misting at a grocery store for 3 hours
5 after misting at a grocery store for 24 hours

Fresh market collards were harvested and handled according to typical fresh market commercial practices. The leaves were cut by hand, bunched together, and bound with a rubber band. Bunches were placed into crates of 18-24 bunches. The crates were transported by truck to the hydrocooling station. A representative sample was taken from the truck. The remaining crates were run through the hydrocooler which consists of a roller conveyor going through a vat of ice water. The time in the vat was about 5-8 minutes. The crates were removed from the hydrocooler and drained on a roller conveyer.

The crates were then opened and a layer of crushed ice (8-10 lb) was placed in the crate and an additional 6-8 lb ice on top of the greens. The crates were closed, sealed, palletized, and placed in a cooler and then a refrigerated truck (37 F) for delivery to the grocery store. The collards were held in a cooler at 36-37 F for 48 hours to simulate transportation by refrigerated truck. The collards were then loaded on trucks (control and treated samples in separate trucks) and delivered to a grocery store. Approximately 9 lb were placed on the produce shelf. A typical grocery store misting system was used over both displays. The produce was misted every 20 minutes for about 20 seconds. Samples were taken at the various points in the process as listed above.

RESULTS. The results of the fresh market processing are presented in Table 2. Samples were stored frozen 1.5 months prior to analysis. Concentration/reduction factors were calculated for the fresh market processing. A concentration/reduction factor is the number which, when multiplied by the residue level at harvest, will result in the residue level after "processing." Apparent residues of maneb in control samples were similar to those found in the decline study. No detectable residues of ETU were found in the control samples.

TABLE 2. MANEB COLLARD FRESH MARKET "PROCESSING" STUDY

	Residues (ppm)		Processing Factors	
Processing step	Maneb	ETU	Maneb	ETU
Plot TA2-TN				
At harvest	1.38	0.082		
After truck	1.03	0.07		
After washing	1.28	0.08		
After 48 hr storage	1.18	0.08		
After 3 hr misting	1.49	0.08		
After 24 hr misting	1.17	0.09	0.85	1.1
Plot TA2-GA				
At harvest	3.363	0.284		
After truck	3.047	0.055		
After washing	3.843	0.075		
After 48 hr storage	3.059	0.098		
After 3 hr misting	2.599	0.070		
After 24 hr misting	2.186	0.077	0.65	0.27
Reanalyzed 10/93	1.678	0.082		
Average Factors			0.75	0.7

The average concentration/reduction factors for fresh market processing (between harvest and purchase at a grocery store) were 0.75x for maneb and 0.7x for ETU.

Handling of Processed Collards. Maneb treated collards collected at the 10 day PHI were sampled at the following points in the processing.

1 after transport to the processing plant
2 after washing
3 after blanching
4 after chilling/washing
5 after chopping and freezing. Both 3 lb boxes and bulk frozen samples were collected.

The collards were placed on a conveyor belt, sorted to remove blemished leaves, washed, blanched, chilled, and chopped. They were sent through a holding tank and into a hema filler. Cartons were filed with 3 lb of chopped collards and sealed. The carton was placed in the freezer at -45 F. Duplicate samples from 5 boxed were taken for analysis. For bulk frozen samples, after the holding tank, the collards were placed on trays and into freezers for about 6 hours. After bulk freezing, the frozen collard clusters were broken into smaller pieces, and channeled into bulk bins. Ten 3 lb samples were taken from the bulk bins. The entire process was monitored by Pictsweet QA personnel in TN to ensure that the processing was typical. At the sampling points in the processing, samples were collected with washed tongs, and placed in polyethylene bags and immediately placed on dry ice in a cooler. The coolers were taken to the Pictsweet Frozen foods freezer for storage.

RESULTS. The results of the processing study following collards from harvest through processing are summarized in Table 3. Samples were stored 1.5 to 5 months before ETU analysis. The average processing factors determined for processed/frozen collards (between harvest and commercial freezing including blanching) are 0.11x for maneb and 0.46x for ETU. Apparent residues of maneb reported in control samples were similar to those reported in the decline study. Apparent residues of maneb were non-detectable after blanching. Apparent residues of ETU were reported in some control samples.

Table 3. MANEB COLLARD PROCESSING STUDY - Collards followed from harvest through freezing (using samples from 10 day PHI)

	Residues (ppm)		Processing Factors	
Processing step	Maneb	ETU	Maneb	ETU
Plot TA1-GA				
At harvest	4.960	0.172		
After truck	5.668	0.485		
After tumbling	2.345	0.229		
After washing	1.943	0.175		
After blanching	0.192	0.123		
After chilling	0.274	0.043		
After freezing	0.359	0.052	0.072	0.300
Reanalysis 10/93	0.261	0.050		
Plot TB1-GA				
At harvest	7.124	0.296		
After truck	11.443	0.789		
After tumbling	5.903	0.416		
After washing	4.410	0.268		
After blanching	1.011	0.144		
After chilling	0.969	0.069		
After freezing	0.832	0.078	0.117	0.264
Reanalysis 10/93	0.981	0.104		
Plot TA1-TN				
At harvest	1.140	0.091		
After truck	1.635	0.095		
After tumbling	1.355	0.067		
After washing	0.789	0.044		
After blanching	0.172	0.134		
After chilling	0.221	0.038		

Table 3. MANEB COLLARD PROCESSING STUDY - Collards followed from harvest through freezing (using samples from 10 day PHI)

	Residues (ppm)		Processing Factors	
Processing step	Maneb	ETU	Maneb	ETU
After freezing	0.241	0.069	0.211	0.758
Plot TB1-TN				
At harvest	2.257	0.123		
After truck	3.557	0.156		
After tumbling	2.790	0.150		
After washing	1.230	0.099		
After blanching	0.299	0.149		
After chilling	0.218	0.105		
After freezing	0.227	0.073	0.101	0.592
	Average processing factors		0.12	0.48

Previously available residue data and exposure assessment. The exposure assessment conducted for all crops is discussed in detail in the references to the PD 2/3 and the PD 4, all of which are found in the EBDC docket. The existing maneb field trial data are summarized in S. Hummel memo of 6/30/88. The calculations involved in the dietary exposure assessment are discussed in detail in the briefing paper for the EBDC grower meeting on February 6, 1990. Additional data submitted since the PD 4 and the incorporation of those data into the dietary exposure assessment are discussed in S. Hummel memo of 8/7/91.

EBDC and ETU Processing Factors Used in PD 4.

Commodity	Ave. EBDC Washing Factor	Ave. ETU Washing Factor	Ave. EBDC Cooking Factor	EBDC to ETU Percent Conversion
Leafy Vegetables	0.30x	0.41x	0.01x	2.5%

Residue Estimates for Dietary Exposure used in PD 4.

Crop/Food Form	Average Residue (ppm) EBDC	ETU
Collards, kale	22	0.11
washed	6.6	0.046
cooked	0.22	0.66
mustard and turnip greens	51	0.15
washed	15.3	0.063
cooked	0.51	1.4

One recent leafy green processing study used for PD 4 included analysis of commercially frozen and cooked turnip greens. The study was conducted by the National Food Processors Association (NFPA). The following results were reported.

NFPA Turnip Green Processing Study (used in PD 4)

Crop/Food Form	Average Residue (ppm) EBDC	ETU
Turnip Greens		
raw	23	0.06
washed	6	0.09
frozen	1.1	0.69
cooked	<0.02	1.1

Calculating a concentration reduction factor for the change in EBDC level when frozen greens are cooked, we divide the maneb residue found in cooked collards, <0.02 ppm, by the maneb residue found in frozen collards, 1.1 ppm, resulting in a factor of <0.02x. We calculate the percent conversion of EBDC to ETU from cooking frozen collards as follows:

$$\frac{(1.1 \text{ ppm ETU} - 0.69 \text{ ppm ETU})}{1.1 \text{ ppm EBDC}} \times 100\% = 37\% \text{ conversion}$$

The conversion factor is calculated without regard for the different molecular weights. This conversion factor will be used with the residue of ETU in frozen collards to estimate the residue of ETU in cooked collards (cooked from frozen).

Summary of factors from the current study

Process	Processing Factor Maneb	ETU
Fresh Market Handling	0.75x	0.7 x
Commercial Processing (Freezing)	0.12x	0.48x

RESIDUE ESTIMATES FOR COLLARDS, MUSTARD AND TURNIP GREENS

The calculations for the residue estimates for cooked greens are shown in attachment 1, separately for greens cooked from fresh greens, and greens cooked from frozen.

For cooked fresh market collards, we estimate that residues of maneb and ETU will be 0.025 ppm and 0.19 ppm, respectively. For cooked frozen (processed) collards, we estimate that the residues of maneb and ETU will be 0.004 ppm and 0.24 ppm, respectively. For raw, washed fresh market collards, we estimate that residues of maneb and ETU will be 1.0 ppm and 0.053 ppm, respectively.

These residue estimates can be weighted for the percentage of processed greens in the Southeast (3.6% for collards, 10.5% for turnip greens, 7.1% for mustard greens). The residue estimates can be translated to mustard and turnip greens. For turnip greens, there must be a practical mechanism to limit use to turnips grown for greens only. This would require input from BEAD. Calculations of weighted average residues for collards, and translated to mustard and turnip greens, are provided in the conclusions.

Good Laboratory Practices. The study was reportedly conducted using Good Laboratory Practices. A list of deviations from GLPs was provided. None of the deviations compromise the integrity of the study.

cc: R.F., circu, S. Hummel, Maneb S.F., Maneb S.R.F. (Hummel), Maneb R.S.F., K. Whitby/CCB, J. Simpson/OGC
RDI:FBS:01/14/94:MM:01/24/94:EZ:01/24/94
7509C:CBII:RM810:CM#2:SVH:svh:01/24/94
File:EBDC11\GREENDEC.C93

Calculations of Residue Estimates Attachment 1

Maneb on Collards after cooking the fresh market commodity
Fresh: 3.37 x 0.75 x 0.01 = 0.025 ppm

The maneb residue at harvest is 3.37 ppm. The EBDC processing factor between harvest and consumer purchase is 0.75x. The cooking factor, which accounts for the reduction of EBDC during cooking is 0.01x.

Maneb on Collards after cooking the frozen (processed) commodity
Frozen: 3.37 x 0.12 x 0.01 = 0.004 ppm

The maneb residue at harvest is 3.37 ppm. The EBDC processing factor between harvest and consumer purchase is 0.11x. The cooking factor, which accounts for the reduction of EBDC during cooking of frozen collards is 0.01x.

ETU on Collards after cooking the fresh market commodity
Fresh: 0.19 x 0.7 + (3.37 ppm x 0.75 x 2.5%) = 0.19 ppm

The amount of ETU present after cooking is the sum of the amount of ETU present before cooking and the amount formed by conversion of the maneb present before cooking. The amount of ETU present at harvest is 0.19 ppm. The processing factor which accounts for the loss of ETU during fresh market processing is 0.7x. The amount of Maneb present before cooking is the amount present at harvest, 3.37 ppm, multiplied by 0.75, the processing factor to adjust for the loss of Maneb during fresh market "processing." That amount of maneb is available to convert to ETU during cooking. The conversion factor for EBDC to ETU during cooking is 2.5%.

ETU on Collards after cooking the frozen (processed) commodity
Frozen: 0.19 x 0.48 + (3.37 ppm x 0.12 x 37%) = 0.24 ppm

The amount of ETU present after cooking is the sum of the amount of ETU present before cooking and the amount formed by conversion of the maneb present before cooking. The amount of ETU present at harvest is 0.19 ppm. The processing factor which accounts for the loss of ETU during commercial processing to produce frozen collards is 0.46x. The amount of Maneb present before cooking is the amount present at harvest, 3.37 ppm, multiplied by 0.11, the processing factor to adjust for the loss of Maneb during commercial processing to produce frozen collards. That amount of maneb is available to convert to ETU during cooking. The conversion factor for EBDC to ETU during cooking of frozen collards is 37%.

ETU in Raw, Washed Collards
Raw, washed: 0.19 ppm x 0.7 x 0.41 = 0.053 ppm

The amount of ETU present at harvest is 0.19 ppm. The ETU is reduced by 0.7x by fresh market processing, and by 0.41x by washing.

Ref #7

DOCKET FILE ENTRY
DOCUMENT COVER SHEET

CBI: _____ Appendix _____ In-Text __X__ No CBI

Docket No 30000/18F Chemical EBDCs

_____ Pre-SR _____ PD1 _____ PD2/3 _____ PD4 _____ Reg Std Post SR

Document Title Maneb on Collards/Field Trials, Residue Decline Studies, Reduction of Residue Study, Final Reports. Doc Date 1/25/94

Author/Affiliation Susan V. Hummel / HED/EPA

Submitter/Affiliation _____

____ Doc Distributed in Meeting Meeting Date __/__/__

____ Doc rec'd/sent by mail or hand delivered Date rec'd/sent __/__/__

Your name/office Amy Porter / SRRD/EPA

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