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FQPA: Economic Impact on Potatoes, Onions, Cabbage and Watermelon Produced in Texas

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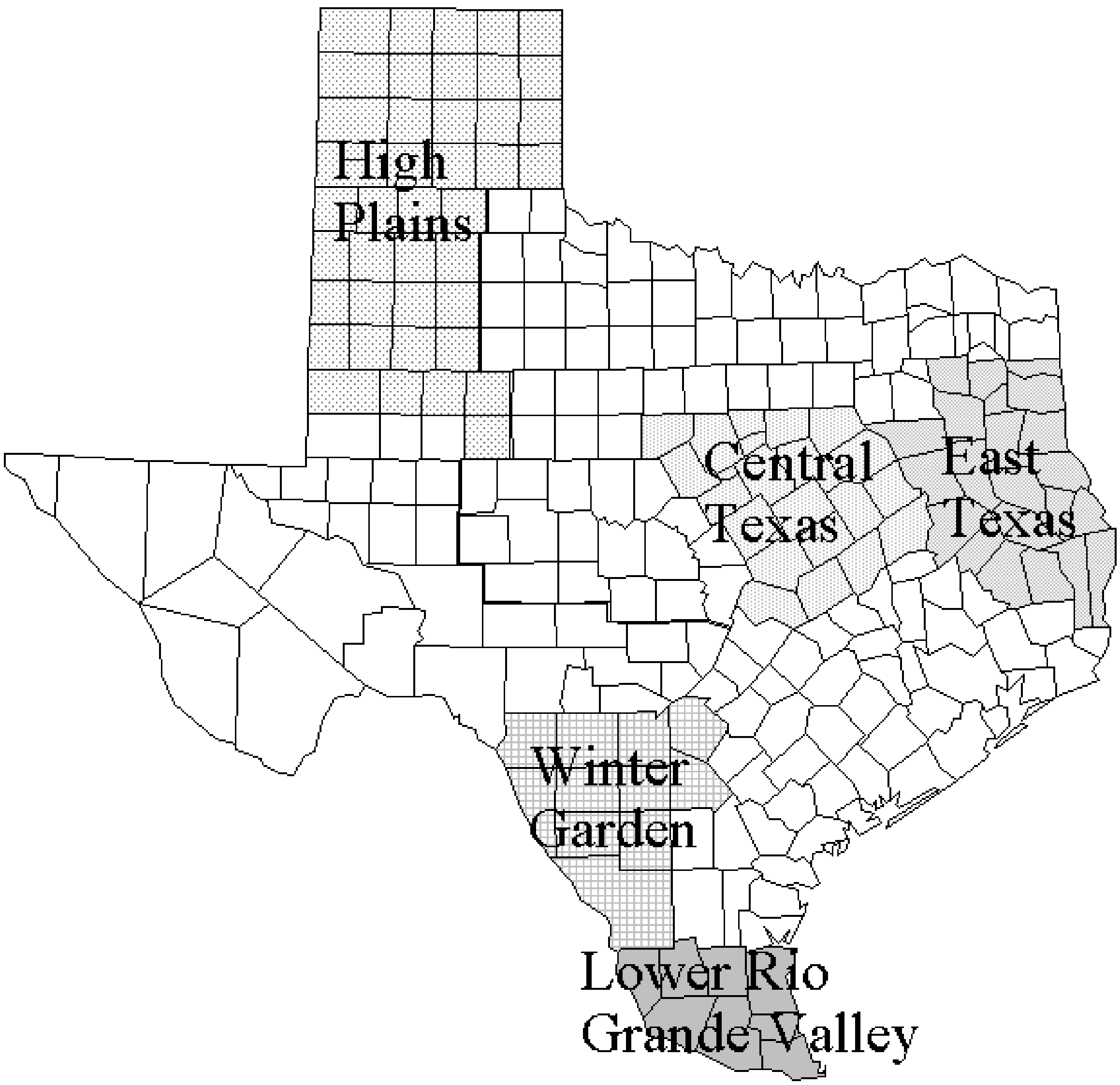

Figure 1. Map of Texas displaying the major growing areas of the study.

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EXECUTIVE SUMMARY

The 1996 Food Quality Protection Act (FPQA) requires the Environmental Protection Agency (EPA) to conduct risk assessments on all pesticides by the year 2006. The EPA has stated it would begin with the pesticides it considers to pose the greatest threat to human health and the environment. These are the carbamates, organophosphates, and those on EPA's B2 carcinogen list. Some pesticide uses could be withdrawn if the risk is determined to be too high. A study was conducted at Texas A&M University to estimate the impact of the loss of key pesticides used to protect potato, onion, cabbage and watermelon crops in Texas. Combined, about 103,755 acres of these crops are harvested in Texas annually. Yearly gross farm receipts from these four crops average $220 million. Texas growers of these crops will lose an estimated $18 million in annual net returns (36 percent drop) if the fungicides maneb/mancozeb (Manex®, Manzate®, Dithane®) are eliminated. Loss of chlorothalonil (Bravo®) will cost growers an estimated $17 million (34 percent decline). If the insecticide diazinon is withdrawn, state net returns for these four crops will be reduced by $8.6 million (17 percent net loss); and withdrawal of the herbicide bensulide (Prefar®) will cost growers $4 million (8 percent reduction). (In this study, net returns is defined as returns to land, labor, management and capital.)

Pest control is critical for abundant production of high quality crops. This is especially true with vegetable crops, where quality cannot be compromised. The study found that if the disease downy mildew is present and not controlled in onions, cabbage or watermelon, yields could decrease by as much as 64 percent. Aphids in watermelon, cabbage or potatoes could reduce yields by 48 percent and whiteflies could reduce yields in watermelon or cabbage by 58 percent. As much as 60 percent yield loss could result in any of the four crops if pigweed or sunflower is not controlled.

The loss of essential fungicides would be most devastating to growers. Onion growers in the Lower Rio Grande Valley could lose up to $7 million without the use of either of two fungicides, chlorothalonil (Bravo®) or maneb/mancozeb (Manex®, Manzate®, Dithane®) which are used in rotation to control the diseases botrytis, downy mildew and purple blotch. A 25 percent increase in farm gate onion prices would be required to offset this loss. High Plains potato growers' net returns would drop by nearly 60 percent ($52 million) without the fungicide propamocarb hydrochloride (Tattoo®). Farm gate potato prices would need to increase by almost 30 percent to make up the difference. Loss of iprodione (Rovral®) to onion growers in the Lower Rio Grande Valley or chlorothalonil (Bravo®) to potato growers in the High Plains would cost more than $3 million. Potato growers in the Winter Garden would lose more than $2.5 million if maneb/mancozeb (Manex®, Manzate®, Dithane®) or chlorothalonil (Bravo®) were no longer available for disease control. Regional net returns of Lower Rio Grande Valley potato growers would decline by more than $1 million annually without the use of maneb/mancozeb (Manex®, Manzate®, Dithane®) or propamocarb hydrochloride (Tattoo®).

Withdrawal of the insecticide phorate (Phorate®, Thimet®) would lower net returns by $5 million for potato growers in the Winter Garden, and by $1.7 million in the High Plains. Potato prices would need to increase more than 30 percent in the Winter Garden and nearly 10 percent in the High Plains to cancel this loss. Watermelon growers in East Texas would suffer declines of $3.2 million, $2.8 million and $2.8 million in regional net returns, respectively, without the use of the insecticides malathion, diazinon and carbaryl (Sevin®). Watermelon price increases of 50 percent with Sevin® loss, 21 percent with malathion loss, and 18 percent with diazinon loss would be required to make up for the lost income. Cabbage growers in the

Lower Rio Grande Valley would lose more than $1 million dollars without diazinon.

The loss of the herbicides EPTC (Eptam®) and metribuzin (Sencor®) would cost Winter Garden potato growers nearly $3 million (82 percent decline in net returns per acre on acres relying on Eptam® treatment) and $1.5 million (34 percent decline in net returns per acre on acres relying on Sencor® treatment), respectively. Potato prices would need to increase by 25 percent to offset the loss of Eptam and by 8 percent if Sencor is canceled. East Texas watermelon growers are in jeopardy of losing $2.8 million if Prefar® is withdrawn. A 10 percent price increase would be needed to make up the loss.

Without accurate data, EPA's pesticide risk assessments will be flawed and some pesticides could be withdrawn needlessly. For example, in some preliminary risk assessments conducted under FQPA, EPA made the assumption that the pesticides were applied at the highest label rate allowed. This assumption greatly exaggerated the amount of pesticide being applied and resulted in highly inaccurate risk estimates. According to this Texas study, actual pesticide application rates average 32 percent lower than the highest rate allowed. The Texas Agricultural Extension Service and the Texas Agricultural Experiment Station are cooperating with the U. S. Department of Agriculture to supply accurate data on pests, pest control practices, and needs in reports called crop profiles. These crop profiles are being made available for use by EPA and are also on the Internet at http://ipmwww.ncsu.edu/opmppiap/.

INTRODUCTION

In 1996 The Food Quality Protection Act (FQPA), or Public Law 104-170, was signed by President Clinton. One of the provisions of the law requires the Environmental Protection Agency (EPA) to conduct risk assessment on all pesticides. All existing pesticide labels must be reviewed by the year 2006. One third must be reviewed within the first 3 years. EPA has stated it would begin the risk assessment process with the pesticides it considers to pose the greatest threat to human health and the environment. These are the carbamates, organophosphates, and those on EPA's B2 carcinogen list, here referred to as FQPA target pesticides. This report examines the change in net returns to Texas growers of potato, onion, cabbage and watermelon crops should use of these pesticides be withdrawn. There are three primary production areas for potatoes, onions and cabbage in Texas--the High Plains, the Winter Garden, and the Lower Rio Grande Valley (Fig. 1). Watermelons are grown throughout the state but the primary production areas are the High Plains, Central Texas, East Texas, the Winter Garden, and the Lower Rio Grande Valley. An estimated 103,755 acres are harvested annually for these four crops (23,750 acres of potatoes, 13,250 acres of onions, 8,355 acres of cabbage, and 58,400 acres of watermelon (Table 1). Estimated annual gross returns for all four crops is $220 million ($62 million for potatoes, $60 million for onions, $36 million for cabbage, and $62 million for watermelon). The combined net returns are $50 million ($16 million for potatoes, $20 million for onions, $8 million for cabbage, and $6 million for watermelon).

METHODS

Data were obtained from published and unpublished reports and expert opinion (see Data Sources). Key growers, crop consultants, and Extension specialists in each major growing area were asked to complete a questionnaire about:

- most damaging pests
- estimates of percent yield loss if these pests were not controlled
- primary FQPA target and non-FQPA target pesticides used
- alternative pesticides that would be used if a particular FQPA target pesticide were withdrawn
- estimates of yield changes resulting from substituting the alternative for the FQPA target pesticide
- pesticide application rates and number of applications per growing season
- harvest costs per crop sale unit
- crop sale price per unit

Respondents were asked to reply "none" if they thought there were no suitable alternative(s) to the particular FQPA target pesticide in question.

Net returns per acre were estimated for each crop 1) with all currently registered pesticides (*actual* net returns) and 2) without individual FQPA target pesticides (*new* net returns) assuming the pesticides are withdrawn. *Actual* net returns per acre were subtracted from *new* net returns per acre. In most cases the result was a negative amount. This figure was multiplied times the number of acres treated with the pesticide in the growing area to obtain the total dollar impact for the area. The *new* net returns were calculated assuming the use of alternative pesticides in most cases. In some cases respondents reported that there are no alternative pesticides.

Equations:

1) $TCNR = CNR \times AT$

Where: $TCNR$ = Total area-wide change in net returns.

CNR = Change per acre in net returns from loss of the pesticide.

AT = Total acres treated with the target pesticide in the growing area.

2) $CNR = NR_A - NR_T$

Where: NR_A = Net returns per acre with alternative in place of target pesticide.

NR_T = Net returns per acre with use of the target pesticide.

3) $NR_A = Y_A \times (P - H) - PH + TP - AP$

Where: Y_A = Yield per acre <u>without</u> the target pesticide available.

P = Farm sale price per cwt of the commodity.

H = Harvest cost per cwt.

PH = Pre-harvest variable costs with use of target pesticide.

TP = Cost of the target pesticide.

AP = Cost of the alternative pesticide. This equals zero where no alternative exists.

4) $NR_T = Y_T \times (P - H) - PH$

Where: Y_T = Yield per acre <u>with</u> the target pesticide available.

Appendix A lists FQPA target and non-FQPA target pesticides by crop.

RESULTS

Sixty experts completed the questionnaire. Respondents identified the primary FQPA target and non-FQPA target pesticides used and the most damaging insects, weeds and diseases encountered. They estimated potential yield loss for each pest if uncontrolled. They estimated the number of acres treated with each primary FQPA target pesticide in the growing area, identified alternative pesticides that would be used if the particular FQPA target pesticide were withdrawn, and estimated yield changes expected if the alternative were substituted for the FQPA target pesticide. They also supplied information on crop yields, crop prices, harvest costs, pesticide application rates, and number of applications per growing season. Questionnaire responses and data such as pesticide prices obtained from other sources were used to estimate the change in grower net returns resulting from the withdrawal of individual FQPA target pesticides.

The following discussion of results is presented by crop, pest and pesticide type, and growing area. For each pest and pesticide type, the most damaging pests are given along with the estimated yield loss when the pests are present and not controlled; the primary FQPA target and non-FQPA target pesticides are given with the number of respondents marking each pesticide; estimates of the impact of withdrawing FQPA target pesticides are reported. This information is given for each growing area, then aggregated for all of Texas.

Respondents often gave different alternatives for FQPA target pesticides. Sometimes the same respondent gave more than one alternative. In the tables, separate estimates of the impact of withdrawal of the FQPA target pesticide are given, one estimate for each alternative. In making the estimates, it is assumed that the alternative for that estimate is applied to all the acres previously treated with the FQPA target pesticide. Where there was more than one estimate, because of more than one alternative product, the estimate used in the statewide aggregate was the one with the least loss in net returns.

In estimating the impact of withdrawing an individual FQPA target pesticide, the *actual* net returns per acre (without the loss of the pesticide) and the *new* net returns per acre (with the loss of the pesticide) were estimated. The impact was determined by subtracting the *actual* net returns from the *new* net returns. In some cases the *new* net returns per acre were less than zero; therefore, the impact estimate was negative with an absolute value greater than *actual* net returns. In these cases growers would be operating at a loss. Growers would not continue to produce the crop at a loss. In such cases, two dollar amounts are reported in the tables with each estimate of impact from loss of a pesticide. One amount gives the impact where *new* per acre net returns are not allowed to drop below zero. This value is labeled *real loss*. The other amount uses the calculated value of the difference between *new* and *actual* net returns even though the *new* net returns are less than zero. This second value will be labeled *total loss*, and captures the total impact of loss of the pesticide even though that loss would not be realized because growers would discontinue production before the loss became that severe. In most cases *new* net returns are greater than zero and the labels *real* and *total* are not used. They are used only in cases where *new* net returns are zero or less and there is a need to report the two values.

Differences between *actual* net returns and *new* net returns are caused by changes in two factors--the change in yield and the change in pesticide costs between having use of all currently registered pesticides and having use of all but the particular FQPA target pesticide in question. All other factors are held constant. On average, estimated *new* yields were 28 percent less than *actual* yields. *New* yields averaged 33 percent less for fungicides withdrawn, 31 percent less for herbicides withdrawn, and 23 percent less for insecticides withdrawn. In 61 percent of the cases where an FQPA target pesticide was replaced with a non-FQPA target pesticide, the cost per acre of pesticide treatment was higher for the non-FQPA target pesticide. Overall, non-FQPA target pesticides cost 70 percent more per acre treated than FQPA target pesticides.

The farm gate price change is given in some cases when discussing the effect of withdrawing FQPA target pesticides. The price change is the difference between the *new* price (price without the target pesticide) and the *actual* price (price with the target pesticide). The *new* price is the price needed for net returns without the target pesticide to equal net returns with the target pesticide. The percent price change is reported in all cases where it is 50 percent or more.

Potatoes

An estimated 23,750 acres of potatoes are harvested annually from the primary production areas in Texas (High Plains, 9,000 acres; Winter Garden, 11,750 acres; Lower Rio Grande Valley, 3,000 acres) (Table 1). Total gross returns are estimated at $62 million (High Plains, $29.3 million; Winter Garden, $26.4 million; Lower Rio Grande Valley, $6.3 million). Total net returns are $15.6 million ($9 million High Plains, $5.3 million Winter Garden, and $1.2 million Lower Rio Grande Valley).

Insects and Insecticides

High Plains

Respondents identified eight insects that cause the most damage to potatoes. The insects and an estimate of percent yield loss if they were uncontrolled are: aphid (70 percent); leaf hopper (70 percent); Colorado potato beetle (57 percent); mite (50 percent); worms (50 percent); grasshopper (50 percent); flea beetle (45 percent); and potato psyllid (43 percent).

Eight FQPA target insecticides are primary insecticides used on potatoes in the Texas High Plains. Beside each insecticide name is the number of respondents who mentioned it: ethoprop (2); phorate (2); azinphos-methyl (1); disulfoton (1); fonofos (1); methamidophos (1); methyl-parathion (1); and oxamyl (1).

Four non-FQPA target insecticides were mentioned: esfenvalerate (2); endosulfan (1); imidacloprid (1); and permethrin (1).

Respondents reported that, together, disulfoton and phorate are applied to about 6,750 acres of potatoes annually in the Texas High Plains (Table 2). Both are FQPA target insecticides. If one were withdrawn, the other would be used to replace it. Loss of disulfoton would reduce area-wide net returns by an estimated $898,000 (10 percent loss). If phorate were lost it would be replaced with disulfoton and area-wide net returns would decline by an estimated $837,000 (9 percent loss). Although these two products can replace each other, yield losses are expected to occur if only one is available because resistance would develop more rapidly. If both were withdrawn, economic losses would be even more severe.

Ethoprop is applied to 4,500 acres annually in the Texas High Plains. A non-FQPA target insecticide--dichloropropene--would be applied if ethoprop were not available. This would result in a loss of $1.253 million (14 percent loss) in year one.

Winter Garden

Respondents noted three insects that cause the most damage to potatoes in the Winter Garden. These, along with an estimate of percent yield loss if uncontrolled, are: potato beetle (63 percent); aphid (41 percent); and leaf hopper (5 percent).

Five primary FQPA target insecticides are important to production: These insecticides and the number of respondents listing them are: phorate (4); methamidophos (4); diazinon (3); oxamyl (3); and disulfoton (1). Primary non-FQPA target insecticides and the number of respondents listing them are: esfenvalerate (4); imidacloprid (4); endosulfan (3); and permethrin (2).

The most damaging loss would be seen if phorate were eliminated. According to respondents, phorate is applied to 11,400 acres of potatoes in the Winter Garden area (97 percent of area potato acreage) (Table 3). If eliminated, it would be replaced by either disulfoton (a FQPA target insecticide) or imidacloprid. Replacing phorate with disulfoton would result in a loss of $5.054 million (94 percent loss) to area-wide net returns. Area-wide net returns would be reduced by $5.184 million (97 percent loss) (*real loss*) or $5.475 million (*total loss*) with imidacloprid as the replacement.

Respondents reported that methamidophos is applied to 3,233 acres of potatoes in the Winter Garden. Both methomyl and imidacloprid were given as possible replacements. Methomyl is a FQPA target insecticide also. Area-wide net returns would decline by $673,000 (13 percent loss) if methamidophos were withdrawn and replaced with methomyl, and by $562,000 (11 percent loss) if replaced with imidacloprid.

Oxamyl is applied to 1,495 acres. Both “none” and phorate were given as alternatives. With no alternative, estimated area-wide net returns would decline by $280,000 (5 percent loss). With phorate as an alternative, estimated area-wide net returns would increase by $228,000 (4 percent increase). Phorate is also a FQPA target insecticide, however. It is curious that oxamyl would be used when the best economic choice would be phorate. It is possible that oxamyl is used in rotation with phorate, and possibly other products, to reduce pest resistance.

Lower Rio Grande Valley

Respondents named five insects that are most damaging to potatoes in the Lower Rio Grande Valley. The insects and an estimate of percent yield loss if uncontrolled are: false chinch bug (50 percent); aphid (15 percent); leafhopper (5 percent); Colorado potato beetle (5 percent); and potato psyllid (5 percent).

Lower Rio Grande Valley respondents listed eight FQPA target insecticides as those primarily used. The insecticides and number of respondents listing them are: methomyl (3); diazinon (2); azinphos-methyl (1); methamidophos (1); methyl-parathion (1); phorate (1); carbaryl (1); and oxamyl (1).

Four non-FQPA target insecticides were listed as primary ones used on potatoes in the Lower Rio Grande Valley: endosulfan (3); esfenvalerate (2); imidacloprid (2); and permethrin (2).

Respondents reported that diazinon is applied to 1,740 acres in the Lower Rio Grande Valley area (Table 4). Imidacloprid would be applied if diazinon were not available. This would result in a 20 percent yield loss and a 110 percent increase in pesticide cost, causing area-wide net returns to decline by 40 percent ($495,000).

According to the respondents, methomyl is applied to 1,305 acres and it would be replaced by esfenvalerate in the absence of methomyl. This would reduce area-wide net returns by $227,000 (18 percent loss) because of a 20 percent yield loss, which out-weighs the advantage of a 23 percent decline in pesticide cost if esfenvalerate were used.

The number of acres treated with methamidophos was not given by questionnaire respondents. Respondents did report, however, that if methamidophos were not available, endosulfan or imidacloprid would take its place. Replacing methamidophos with endosulfan would result in a decrease of $373 per acre in net returns (91 percent loss). There would be a decrease of $400 per acre (97 percent loss) if replaced with imidacloprid.

All of Texas

Potato growers in all three growing areas use phorate for insect control. It is applied to an estimated 14,775 acres. Eliminating phorate would reduce net returns statewide by 38 percent ($5.891 million).

Weeds and Herbicides

High Plains

Weeds most damaging to potatoes in the High Plains, and an estimate of percent yield loss if they are not controlled, are: pigweed (65 percent); nutsedge (35 percent); bindweed (20 percent); and Russian thistle (20 percent).

High Plains respondents said the primary FQPA target herbicides used are: metribuzin (2 respondents); and EPTC (1).

Five non-FQPA target herbicides were listed as primary ones used: metolachlor (2); paraquat (2); DCPA (1); sethoxydim (1); and pendimethalin (1).

Metribuzin is applied to an estimated 4,500 acres in the High Plains (Table 2). Respondents said no substitute is available but also that no change in yield would result if metribuzin were not applied. Given these responses, area-wide net returns would increase by $149,000 (2 percent) if metribuzin were not applied (the amount saved by not applying metribuzin). The results here are misleading because metribuzin is not applied every year, only when there is a sufficient weed problem to merit its use. Generally a pre-emergence herbicide is applied to take care of early weeds and then the potato plants provide a large enough canopy to shade out weeds that emerge later. Metribuzin is the only post-emergent herbicide available for use on potatoes, but is labeled for use on only one of the two major potato varieties grown in the High Plains. Although its use is limited, it is needed and does help protect the crop from weed competition and yield loss when late weeds are a problem.

Winter Garden

Fourteen weeds were named as most damaging to potatoes in the Winter Garden. The weeds and the estimated percent yield loss if not controlled are: sandbur (88 percent); field grasses (68 percent); nutsedge (69 percent); yellow top (58 percent); sunflower (53 percent); goathead (50 percent); Texas panicum (48 percent); pigweed (45 percent); morning-glory (23 percent); Bermuda grass (14 percent); purslane (12 percent); and Johnson grass (8 percent).

Winter Garden growers said two FQPA target herbicides are used: metribuzin (4 respondents); and EPTC (3).

Five non-FQPA target herbicides were listed: metolachlor (4); sethoxydim (4); pendimethalin (4); paraquat (3); and glyphosate (3).

Respondents reported that EPTC is applied to 7,963 acres in the Winter Garden area (Table 3). Some said no alternative to EPTC is available and some said metolachlor is an alternative. Assuming no alternative, area-wide net returns would decline by $3.621 million (68 percent loss) (*real loss*), or $3.784 million (*total loss*), in year one. With metolachlor as an alternative, although pesticide cost would decline by 41 percent, yield would drop by an estimated 33 percent and cause area-wide net returns to decline by $2.963 million (55 percent loss).

Metribuzin is applied to 9,983 acres and it would be replaced by pendimethalin in the absence of metribuzin. This would reduce area-wide net returns by $1.531 million (29 percent loss).

Lower Rio Grande Valley

Seven weeds were identified as most damaging to potatoes in the Lower Rio Grande Valley. The weeds, and an estimate of yield loss if they were not controlled, are: Texas panicum (50 percent); Johnson grass (50 percent); barnyard grass (40 percent); sunflower (35 percent); pigweed (30 percent); nutsedge (25 percent); and purslane (5 percent).

No FQPA target herbicides were selected by respondents as primary herbicides used to control weeds in potatoes in the Lower Rio Grande Valley.

Seven non-FQPA target herbicides were listed by respondents as primary ones used. They are: pendimethalin (4 respondents); sethoxydim (4); metolachlor (3); glyphosate (2); paraquat (1); linuron (1); and trifluralin (1).

Assuming no FQPA target herbicides are used in the Lower Rio Grande Valley to control weeds in potatoes, their withdrawal would not affect potato production in that area.

All of Texas

Metribuzin is applied to a total of 14,483 acres of potatoes in the High Plains and Winter Garden areas. Eliminating metribuzin would reduce net returns statewide by $1.383 million. That is a 9 percent decline in statewide potato net returns.

Diseases and Fungicides

High Plains

Respondents named five diseases that are most damaging to potatoes in the High Plains. The diseases and an estimate of percent yield loss potential if they are not controlled are: late blight (75 percent); early blight (60 percent); seed piece decay complex (60 percent); nematodes (50 percent); and tuber rot (35 percent).

Six FQPA target fungicides were considered primary ones used. The fungicides and number of respondents listing them are: chlorothalonil (2); mancozeb (2); propamocarb (2); captan (1); iprodione (1); and maneb (1).

Five non-FQPA target fungicides were listed: thiophanate-methyl (2); copper (2); thiobendazole (1); mefenoxam + copper (1); and triphenyltin hydroxide (1).

Respondents reported that propamocarb is applied to 9,000 acres of potatoes in the High Plains area (Table 2). Cymoxanil and dimethomorph were given as alternatives if propamocarb becomes unavailable. The effect of losing propamocarb and using cymoxanil in its place would be a reduction in area-wide net returns of $5.177 million (57 percent loss). The loss would be $5.785 million (64 percent) if dimethomorph were used as the alternative.

Chlorothalonil and mancozeb are applied to 9,000 acres. Losing chlorothalonil or mancozeb would result in a $3.287 million (36 percent) or $3.112 million (34 percent) loss, respectively, if replaced with cymoxanil. If replaced with dimethomorph the loss would be $4.199 million (47 percent) and $3.517 million (39 percent), respectively. These dollar amounts assume the loss of only one or the other but not both chlorothalonil and mancozeb. Since they are both FQPA target pesticides, both are in jeopardy, however. We do not have sufficient data to estimate the impact of losing both of these products.

Captan seed treatment is applied to 7,650 acres of potatoes in the High Plains. Respondents reported that either thiophanate-methyl or fludioxonil would be applied if captan were not available. Estimated area-wide impact of losing captan would be a loss of $740,000 (8 percent) if replaced with thiophanate-methyl or $505,000 (6 percent) if replaced with fludioxonil.

Winter Garden

Diseases most damaging to potatoes in the Winter Garden, and an estimate of percent yield loss if they are not controlled, are: late blight (90 percent); nematodes (28 percent); early blight (23 percent); seed piece decay (6 percent); blackleg (5 percent); and tuber rot (2 percent).

Four FQPA target fungicides are primary ones used in the Winter Garden: chlorothalonil (4 respondents); mancozeb (4); maneb (4); and propamocarb (4).

Seven non-FQPA target fungicides are also primary ones used: thiophanate-methyl (4); mefenoxam + copper (4); triphenyltin hydroxide (4); thiobendazole (3); copper + zinc (3); copper (3); and sulfur (3).

Respondents estimated that chlorothalonil is applied to 11,750 acres of potatoes in the Winter Garden area (Table 3). Chlorothalonil alternatives given were none and triphenyltin hydroxide. With no alternative, the impact of losing chlorothalonil is a decline of $5.343 million (100 percent loss) (*real loss*), or $5.923 million (*total loss*), in area-wide net returns in year one. There would be a loss of $2.613 million (49 percent) in year one if triphenyltin hydroxide were substituted.

An estimated 11,000 acres of potatoes are treated with mancozeb in the Winter Garden. None, chlorothalonil, and mefenoxam were given as alternatives to mancozeb. Losing mancozeb with no replacement would result in a $2.874 million loss (54 percent). Using mefenoxam in place of mancozeb would result in an estimated $2.717 million loss (51 percent). Area-wide net returns would decline by an estimated $981,000 (18 percent) with chlorothalonil as an alternative. Recall that chlorothalonil is also an FQPA target pesticide and in danger of being eliminated.

Maneb is applied to an estimated 11,000 acres. Triphenyltin hydroxide would replace maneb if maneb were not available. This change in disease control products would cost area growers an estimated $2.666 million (50 percent loss).

Propamocarb is applied to 3,493 acres. None and triphenyltin hydroxide were given as alternatives. Assuming no alternative were used, area-wide net returns would decrease by $937,000 (18 percent loss). If triphenyltin hydroxide were substituted for propamocarb, area-wide net returns would be reduced by $694,000 (13 percent loss).

Lower Rio Grande Valley

Respondents named two diseases that are most damaging to potatoes in the Lower Rio Grande Valley: late blight (85 percent yield loss if not controlled); and early blight (35 percent yield loss if not controlled).

Primary fungicides used include these FQPA target products: chlorothalonil (4 respondents); mancozeb (4 respondents); maneb (3 respondents); propamocarb (3 respondents); captan (1 respondent); iprodione (1 respondent); and metam-sodium (1 respondent).

Five non-FQPA target fungicides were listed also: mefenoxam + copper (2); thiophanate-methyl (1); streptomycin sulfate (1); copper + zinc (1); and copper (1).

Respondents estimated that chlorothalonil is applied to 2,175 acres of potatoes in the Lower Rio Grande Valley (Table 4). Both none and cymoxanil were given as alternatives. Assuming no alternative were used, area-wide net returns would decline by an estimated $895,000 (73 percent) (*real loss*), or $1.267 million (*total loss*). With cymoxanil replacing chlorothalonil, the loss would be $700,000 (57 percent).

Respondents reported that 2,900 acres of potatoes in the Lower Rio Grande Valley were treated with mancozeb, maneb, iprodione, and propamocarb and that there are no alternatives. Given this scenario, area-wide net returns would be reduced by $1.193 million (97 percent) (*real loss*), with the loss of any one of these fungicides. *Total loss* is estimated at $1.735 million, $1.927 million, $1.533 million, or $1.827 million with the loss of mancozeb, maneb, iprodione, or propamocarb, respectively.

The FQPA target fungicide captan is used as a seed treatment. Without it, growers would use fludioxonil as a foliar treatment. Data is not available on the number of acres treated with captan in the Lower Rio Grande Valley. On acres that rely on this seed treatment, however, losing captan would result in an estimated $321 loss in net returns (78 percent) per acre.

All of Texas

From questionnaire results an estimated 22,925 acres of Texas potatoes are treated with chlorothalonil annually. If label use for chlorothalonil is revoked and cymoxanil is used in its place in the High Plains and the Lower Rio Grande Valley and thiophanate-methyl is used as a replacement fungicide in the Winter Garden, estimated statewide net returns would be reduced by $6.6 million (43 percent).

An estimated 22,900 acres of Texas potatoes are treated with mancozeb. Assuming no alternative in the Lower Rio Grande Valley, cymoxanil as an alternative in the High Plains, and mefenoxam as a replacement in the Winter Garden, the loss of mancozeb would cost Texas potato growers $5.287 million (35 percent) in net returns in year one.

Propamocarb is applied to 15,393 acres. Cymoxanil was given as an alternative for the High Plains and triphenyltin hydroxide for the Winter Garden. Questionnaire respondents said there is no replacement in the Lower Rio Grande Valley. With these alternatives, if propamocarb were eliminated, potato growers' net returns for the state would decrease by $7.065 million (46 percent).

Respondents reported that iprodione and captan are used in the High Plains and the Lower Rio Grande Valley. There was not sufficient information to estimate the impact of the loss of iprodione in the High Plains or the loss of captan in the Lower Rio Grande Valley. Loss of iprodione in the Lower Rio Grande Valley alone reduces statewide net returns by 8 percent. Loss of captan in the High Plains reduces statewide net returns by 3 percent.

Onions

An estimated 13,250 acres of onions are harvested in the three major growing areas annually (Table 1). In the High Plains 759 acres are harvested, in the Winter Garden 3,150 acres, and in the Lower Rio Grande Valley 9,350 acres. Total annual gross returns for the three areas combined is estimated at $59.6 million ($3.4 million High Plains, $17.4 million Winter Garden, and $38.8 million Lower Rio Grande Valley). Estimated net returns for the three areas combined is $19.6 million ($353,000 High Plains, $5.7 million Winter Garden, and $13.5 million Lower Rio Grande Valley).

Insects and Insecticides

High Plains

Respondents identified three insects that cause the most damage to onions grown in the High Plains. These insects and an estimate of percent yield loss if there were no control effort are: onion thrip (45 percent); western flower thrip (45 percent); and wireworm (15 percent).

Three FQPA target insecticides were identified as of primary importance. The insecticides and the number of respondents mentioning them are: methyl-parathion (3); methomyl (3); and oxamyl (2).

Two non-FQPA target insecticides were named as primary insecticides used. They are: cypermethrin (3) and lambda-cyhalothrin (2).

Respondents reported that methyl-parathion is applied to about 590 acres annually in the Texas High Plains (Table 5). Four alternatives to methyl-parathion were given: methomyl and oxamyl (also FQPA target insecticides); imidacloprid; and cypermethrin. Replacing methyl-parathion with methomyl would reduce area-wide net returns by $127,000 (36 percent). Net returns would decline by $111,000 (32 percent), $128,000 (36 percent), or $118,000 (33 percent) if methyl-parathion were replaced with oxamyl, imidacloprid, or cypermethrin, respectively.

Methomyl is applied to 405 acres of onions in the High Plains. Respondents identified five insecticides that would be used in its place if methomyl were no longer available: methyl-parathion and oxamyl (also FQPA target insecticides); cypermethrin; lambda-cyhalothrin; and imidacloprid. If lambda-cyhalothrin were used, net returns would increase $11,000. Area-wide net returns would decrease an estimated $500, $30,000, $66,000, and $76,000, respectively, if methomyl were replaced with methyl-parathion, cypermethrin, oxamyl, or imidacloprid.

Respondents reported applying oxamyl to 23 acres. Methomyl and methyl-parathion (also FQPA target insecticides), along with cypermethrin, lambda-cyhalothrin, and imidacloprid were given as alternatives in the event oxamyl is withdrawn. Area-wide net returns would decrease by $5,000, $4,000, $500 and $5,000, respectively, if methomyl, methyl-parathion, cypermethrin or imidacloprid were substituted area-wide. Net returns would increase by $100 if lambda-cyhalothrin were the alternative used.

Winter Garden

Respondents identified five insects causing the most damage to onions in the Winter Garden: white grubs (75 percent loss if uncontrolled); onion maggots (55 percent); onion thrips (50 percent); western flower thrips (40 percent); wireworms (30 percent); flea beetles (30 percent); and mites (30 percent).

Four FQPA target insecticides were identified as primary insecticides used on onions: diazinon (6 respondents); chlorpyrifos (3); methomyl (3); and oxamyl (3).

Three non-FQPA target insecticides were selected: permethrin (5); cypermethrin (4); and lambda-cyhalothrin (4).

Winter Garden onion growers apply methomyl to 2,250 acres annually (Table 6). Lambda-cyhalothrin, cypermethrin or permethrin would take the place of methomyl if it were not available. Replacing methomyl with lambda-cyhalothrin would cost area growers an estimated $772,000 (13 percent loss) in net returns. Net returns would be reduced by $773,000 (13 percent) if cypermethrin were used or by $1.563 million (27 percent) if permethrin were used.

An estimated 2,125 acres of Winter Garden onions are treated with oxamyl. Respondents report that cypermethrin or lambda-cyhalothrin would replace oxamyl. Area-wide net returns would increase an estimated $5,000 with cypermethrin and decrease an estimated $7,000 with lambda-cyhalothrin as replacements to oxamyl.

Diazinon is applied to 1,575 acres. Alternatives listed were none, chlorpyrifos (also a FQPA target insecticide), permethrin and cypermethrin. If no alternative were used the effect on area-wide net returns would be a loss of $996,000 (17 percent). Using chlorpyrifos or permethrin would decrease returns by $478,000 (8 percent) or $6,000, respectively. Cypermethrin would bring an increase in area-wide net returns of $87.

Chlorpyrifos is applied to 1,500 acres of onions in the Winter Garden. If it were eliminated the alternatives would be none, diazinon (also a FQPA target insecticide) and lambda-cyhalothrin. With no alternative, estimated loss to growers would be $693,000 (12 percent). Replacing chlorpyrifos with diazinon would decrease area-wide net returns by an estimated $357,000 (6 percent loss). Returns are estimated to increase by $8,000 if lambda-cyhalothrin is used in place of chlorpyrifos.

Lower Rio Grande Valley

Respondents identified nine insects that cause the most damage to onions in the Lower Rio Grande Valley. Estimates of yield loss if these insects were uncontrolled are shown in parenthesis: cutworms (40 percent); darkling beetles (40 percent); onion thrips (37 percent); western onion thrips (37 percent); white grubs (22 percent); armyworms (16 percent); wireworms (16 percent); onion maggots (13 percent); and leafminers (2 percent).

Six FQPA target insecticides were identified as the primary ones used on onions: diazinon (6 respondents); methomyl (6); oxamyl (3); azinphos-methyl (1); chlorpyrifos (1); and methyl-parathion (1).

Three non-FQPA target insecticides were also selected: cypermethrin (5); lambda-cyhalothrin (4); and permethrin (3).

According to questionnaire responses, azinphos-methyl is applied to 8,800 acres of onions in the Lower Rio Grande Valley (Table 7). Permethrin would be applied in the absence of azinphos-methyl. There was not sufficient data to calculate the economic effect of losing azinphos-methyl and using permethrin in its place.

Methomyl is applied to 8,225 acres of onions. None, three FQPA target insecticides (diazinon, methyl-parathion and oxamyl), and three non-FQPA target insecticides (lambda-cyhalothrin, cypermethrin and permethrin) were all given as alternatives. With no replacement for methomyl, area-wide net returns would decrease by $4.147 million (31 percent). The loss in net returns would be $3.238 million (24 percent loss) with diazinon as the alternative, $2.906 million (21 percent) with methyl-parathion, $2.999 million

(22 percent loss) with oxamyl, $676,000 (5 percent) with lambda-cyhalothrin, $330,000 (2 percent) with cypermethrin, and $2.188 million (16 percent) with permethrin.

Diazinon is used to treat 8,098 acres in the Lower Rio Grande Valley. Respondents to the questionnaire reported none or cypermethrin as alternatives in the event diazinon is not available. With no alternative insecticide, area-wide net returns would decline by $3.498 million (26 percent). Lack of sufficient data makes it impossible to calculate the effect of using cypermethrin as the alternative.

Oxamyl is applied to 2,653 acres. Alternatives are none, diazinon, methyl-parathion, and methomyl (all FQPA target insecticides). If oxamyl is withdrawn and no treatment is made, area-wide net returns would decrease by an estimated $1.308 million (10 percent). Replacing oxamyl with diazinon would cost growers $1.064 million (8 percent loss). Using methomyl would bring a loss of $1.005 million (7 percent loss). Substituting methyl-parathion would cost $957,000 (7 percent loss).

Nine hundred acres are treated with chlorpyrifos. No alternative is available. Loss of chlorpyrifos would cost area onion growers $906,000 (7 percent) in net returns.

All of Texas

Texas onion growers apply methomyl to 10,880 acres. Both cypermethrin and lambda-cyhalothrin are given as alternatives in all three major growing regions. Replacing methomyl with cypermethrin would decrease statewide net returns by $1.103 million (6 percent). If methomyl were replaced with lambda-cyhalothrin, statewide net returns would decline by an estimated $1.437 million (7 percent loss).

Respondents reported that diazinon is used in both the Winter Garden and the Lower Rio Grande Valley. Total acres treated are 9,673. There was no report of its use in the High Plains. With no alternative, loss of diazinon would mean an estimated loss of $3.498 million (18 percent) in net returns statewide.

Onion growers in all three areas use oxamyl for insect control, with an estimated 4,801 acres statewide treated annually. Several alternatives were given for oxamyl. Replacing it with the most economically logical alternatives would cause onion growers' net returns to decrease $952,000. That is 5 percent of estimated state net returns.

An estimated 2,400 acres of onions are treated with chlorpyrifos in the Winter Garden and the Lower Rio Grande Valley. Using the most economical alternatives given, loss of chlorpyrifos would cost growers an estimated $898,000, or 5 percent.

Methyl-parathion is applied in the Lower Rio Grande Valley and the High Plains to a total of 1,602 acres. Loss of methyl-parathion would result in a decrease of $499,000 (3 percent) in net returns statewide, assuming the most economical alternatives are used.

Weeds and Herbicides

High Plains

Respondents named four weeds most damaging to onions in the High Plains. The weeds, and an estimate of percent yield loss if not controlled, are: pigweed (50 percent); iron weed (50 percent), nutgrass (yellow and purple) (5 percent); and Bermuda grass (3 percent).

Respondents listed no FQPA target herbicides as primary ones used in the High Plains.

Six non-FQPA target herbicides were listed by respondents as primary ones used on onions in the High Plains: trifluralin (3 respondents);

oxyfluorfen (2); bromoxynil (2); paraquat (1); sethoxydim (1); and DCPA (1).

Since there was no report of FQPA target herbicides used in the High Plains, there are no estimates of impact from loss.

Winter Garden

Respondents identified fourteen weeds that are most damaging to onions in the Winter Garden rag weed (100 percent); yellow top (100 percent); field grass (100 percent); pigweed (92 percent); sunflower (91 percent); purslane (90 percent); careless weed (83 percent); wild mustard (50 percent); thistle (50 percent); lambs quarter (50 percent); Johnson grass (46 percent); Texas panicum (40 percent); nutgrass (40 percent); and henbit (20 percent).

One questionnaire respondent reported that the FQPA target herbicide metolachlor-metribuzin is a primary herbicide used in the Winter Garden.

Seven non-FQPA target herbicides were listed by respondents: sethoxydim (6 respondents); oxyfluorfen (5); bromoxynil (5); trifluralin (5); DCPA (2); glyphosate (2); and paraquat (1).

Questionnaire respondents did not give sufficient information to estimate the impact of the withdrawal of FQPA target herbicides.

Lower Rio Grande Valley

Respondents said 17 weeds are most damaging to onions in the Lower Rio Grande Valley. The weeds and an estimate of percent yield loss if they are not controlled are: sunflower (90 percent); pigweed (78 percent); purslane (70 percent); Bermuda grass (70 percent); lambs quarter (60 percent); prostrate spurge (50 percent); London rocket (40 percent); ground cherry (40 percent); wild croton (40 percent); Texas panicum (30 percent); sow thistle (30 percent); spotted spurge (25 percent); barn yard daisy (20 percent); mustard (20 percent); nightshade (10 percent); and bindweed (5 percent).

Two respondents listed the FQPA target herbicide bensulide as a primary herbicide used in the Lower Rio Grande Valley.

Non-FQPA target herbicides, and the number of respondents listing them, are: oxyfluorfen (5); DCPA (4); sethoxydim (3); bromoxynil (2); paraquat (1); and pendimethalin (1).

Onion growers in the Lower Rio Grande Valley applied bensulide to 8,800 acres (Table 7). Respondents reported that no alternative is available. There was insufficient data to estimate the economic impact of losing bensulide.

Diseases and Fungicides

High Plains

Respondents named seven diseases that are most damaging to onions. The diseases and an estimate of percent yield loss if they are not controlled are: downy mildew (75 percent); black mold (43 percent); purple blotch (33 percent); powdery mildew (20 percent); tip blight (10 percent); pink root (2 percent); and nematode (1 percent).

High Plains respondents named these FQPA target fungicides as most used: chlorothalonil (3 respondents); iprodione (3); mancozeb (3); fosetyl-aluminum (2); and dichloropropene (1).

Four non-FQPA target fungicides were listed: mefenoxam (3); metalaxyl (2); copper (2); and sulfur (1).

High Plains onion growers apply chlorothalonil to 725 acres (Table 5). If it were not available they would apply iprodione (also a FQPA target fungicide). This change would result in a decrease in area-wide net returns of $125,000 (35 percent).

Mancozeb is applied to 725 acres. Without it growers would use chlorothalonil or iprodione (also FQPA target fungicides). Area-wide net returns would decline about $145,000 (41 percent loss) with chlorothalonil as the alternative and $140,000 (40 percent loss) with iprodione.

It was reported that dichloropropene is applied to 363 acres and no alternative is available. Loss of dichloropropene would result in an estimated $14,000 (4 percent loss) in area-wide net returns.

An estimated 363 acres of High Plains onions are treated with iprodione. Chlorothalonil or mancozeb (also FQPA target fungicides) would be used in the absence of iprodione. Net returns would be reduced by an estimated $20,000 (6 percent) with chlorothalonil and $18,000 (5 percent) with mancozeb.

Winter Garden

The diseases most damaging to onions in the Winter Garden, and an estimate of yield loss if they are not controlled, are: botrytis (100 percent); purple blotch (81 percent); downy mildew (74 percent); black mold (65 percent); basal rot (63 percent); powdery mildew (56 percent); tip blight (50 percent); pink rot (50 percent); blast (50 percent); and nematode (50 percent).

FQPA target fungicides used and the number of respondents listing them are: chlorothalonil (5); iprodione (5); mancozeb (5); fosetyl-aluminum (4); thiram (3); and captan (2).

Non-FQPA target fungicides are: metalaxyl (5); mefenoxam (4); copper (4); thiophanate-methyl (1); and sulfur (1).

Chlorothalonil is applied to 3,150 acres of onions in the Winter Garden (Table 6). None , iprodione and mancozeb (both FQPA target fungicides), fosetyl-aluminum, metalaxyl, thiophanate-methyl, and copper were listed as alternatives if chlorothalonil were lost. The estimated impact on area-wide net returns of using these alternatives in place of chlorothalonil is: $3.573 million loss (62 percent) with none; $2.297 million loss (40 percent) with thiophanate-methyl; $1.804 million loss (31 percent) with copper; $1.411 million loss (25 percent) with mancozeb; $1.409 million loss (25 percent) with metalaxyl; $154,000 loss (3 percent) with iprodione; and $13,000 gain with fosetyl-aluminum.

An estimated 2,615 acres are treated with mancozeb, for which chlorothalonil/metalaxyl, copper + sulfur, or fosetyl-aluminum could be substituted. Chlorothalonil is also a FQPA target fungicide. Replacing mancozeb with chlorothalonil/metalaxyl would reduce net returns by $1.391 million (24 percent loss). With copper + sulfur as the replacement the loss in net returns would be $1.25 million (22 percent). Fosetyl-aluminum would bring a loss of $979,000 (17 percent).

Maneb is applied to about 2,363 acres. If unavailable, chlorothalonil (also a FQPA target fungicide) or copper would be used. Replacing maneb with chlorothalonil would reduce area-wide net returns by an estimated $77,000 (1 percent). Using copper would cause a $1.412 million loss (24 percent).

Iprodione is applied to 2,000 acres of onions. Alternatives are none, chlorothalonil (also a FQPA target fungicide), vinclozolin, copper, and fosetyl-aluminum. With no alternative Winter Garden onion growers would lose $2.253 million (39 percent). With copper as an alternative, their loss would be $1.083 million (19 percent). The decrease in net returns would be $918,000 (16 percent) with vinclozolin. Fosetyl-aluminum and chlorothalonil would increase net returns by $1,000 and $23,000, respectively.

Lower Rio Grande Valley

Respondents named 12 diseases that are most damaging to onions in the Lower Rio Grande Valley. Estimated yield losses if they are not controlled are shown in parentheses: purple blotch (51 percent); downy mildew (50 percent); stemphylium (43 percent); powdery mildew (35 percent); tip blight (27 percent); blast (20 percent); pink rot (21 percent); basal rot (14 percent); black mold (12 percent); nematode (5 percent); botrytis (2 percent); and bacterial infections (2 percent).

Lower Rio Grande Valley growers use these FQPA target fungicides: iprodione (6 respondents); mancozeb (6); fosetyl-aluminum (6); chlorothalonil (5); captan (1); and thiram (1).

These non-FQPA target fungicides were listed: metalaxyl (5); mefenoxam (3); copper (3); dicloran (2); and sulfur (1).

Chlorothalonil is applied to 9,350 acres (Table 7). Alternatives listed were: none; iprodione and maneb (also FQPA target fungicides); sulfur; and thiophanate-methyl. Using no alternative would reduce area-wide net returns by an estimated $11.915 million (88 percent). With sulfur as an alternative, loss would be about $13.539 million (100 percent) (*real loss*), $17.034 million (*total loss*). An estimated $7.311 million (54 percent) would be lost with iprodione, and $6.454 million (48 percent) with maneb. There was not enough data to estimate the impact of using thiophanate-methyl in place of chlorothalonil.

Growers apply maneb to 9,250 acres. Iprodione or chlorothalonil (also FQPA target fungicides) or sulfur would be applied in the absence of maneb. Estimated decline in net returns with sulfur as an alternative is $13.394 million (99 percent loss) (*real loss*), 17.04 million (*total loss*). The loss would be about $7.506 million (55 percent) with iprodione and $6.867 million (51 percent) with chlorothalonil.

Based on the questionnaire results, mancozeb is applied to 9,000 acres of onions in the Lower Rio Grande Valley. Alternatives reported are none or fosetyl-aluminum. With no alternative to mancozeb, growers in the area would lose an estimated $9.744 million (72 percent) in net returns. No estimate was made for using fosetyl-aluminum to replace mancozeb because of insufficient data.

Iprodione is applied to 8,900 acres of onions in the Lower Rio Grande Valley. In its absence, respondents said these substitutes would be used: none; chlorothalonil and maneb (also FQPA target fungicides); dicloran; sulfur; and metalaxyl. With no alternative, area-wide net returns would be reduced by an estimated $12.185 million (90 percent). Estimated net returns for the area would drop by $12.887 million (95 percent) (*real loss*), $15.738 million (*total loss*) with sulfur as an alternative; $10.603 million (78 percent) with dicloran; $6.112 million (45 percent) with chlorothalonil; $5.910 million (44 percent) with maneb; and $3.376 million (25 percent) with metalaxyl.

Respondents reported using thiram for seed treatment on 9,000 acres. There was insufficient data, however, to estimate the impact of its loss.

All of Texas

Chlorothalonil is applied to 13,225 acres of onions statewide. Several different alternatives were given. Replacing it with the most logical economic alternatives would reduce net returns statewide by $6.566 million (33 percent loss).

Mancozeb is used in all three major onion growing areas and applied to an estimated 12,340 acres. Several alternatives were given. Using the most economically viable alternatives to mancozeb would bring a loss of $9.983 million (51 percent) statewide.

Maneb is applied to 11,613 acres of onions, mainly in the Winter Garden and the Lower Rio Grande Valley. Using the alternatives that make the most economic sense, the estimated impact of losing maneb is a loss of $6.944 million (35 percent loss) in statewide net returns.

An estimated 11,009 acres of onions are treated with iprodione statewide. The impact of losing iprodione is estimated to be a $3.372 million loss (17 percent), assuming the most economically viable alternatives are used.

Thiram is applied to 10,800 acres of onions statewide. There is insufficient data to estimate the impact of its loss.

Cabbage

An estimated 8,355 acres of cabbage are harvested in the three major growing areas (425 acres in the High Plains, 3,630 acres in the Winter Garden, and 4,300 acres in the Lower Rio Grande Valley). Total statewide cabbage gross returns is estimated at $36.2 million ($1.5 million High Plains, $16.3 million Winter Garden, and $18.3 million Lower Rio Grande Valley). Estimated statewide net returns total $8.2 million ($488,000 High Plains, $3.4 million Winter Garden, and $4.4 million Lower Rio Grande Valley).

Insects and Insecticides

High Plains

Respondents identified four insects that cause the most damage to cabbage grown in the High Plains. These insects and an estimate of percent yield loss if uncontrolled are: diamondback moths (88 percent); flea beetles (83 percent); cabbage loopers (68 percent); and aphids (25 percent).

Seven FQPA target insecticides were identified as primary insecticides used on cabbage in the Texas High Plains. The insecticides and the number of respondents specifying them are: methyl-parathion (2); methomyl (2); chlorpyrifos (1); diazinon (1); methamidophos (1); carbaryl (1); and thiodicarb (1).

Three non-FQPA target insecticides were selected by respondents as primary insecticides used: cypermethrin (1); esfenvalerate (1); and lambda-cyhalothrin (1).

Carbaryl and thiodicarb are both applied to an estimated 417 acres of cabbage in the Texas High Plains (Table 8). Respondents reported that there is no alternative for carbaryl and that *Bacillus thuringiensis* would be applied in place of thiodicarb if thiodicarb were lost. Loss of carbaryl would reduce area-wide net returns by an estimated $300,000 (61 percent loss). If thiodicarb were replaced with *Bacillus thuringiensis* area-wide net returns would decline by about $369,000 (76 percent loss).

An FQPA target insecticide, methyl-parathion, is applied to 380 acres of cabbage in the Texas High Plains. If methyl-parathion is lost it will be replaced with malathion (also a FQPA target insecticide) or *Bacillus thuringiensis*. Growers would lose $448,000 (92 percent) in net returns applying malathion in place of methyl-parathion, and $345,000 (71 percent) applying *Bacillus thuringiensis*.

Three hundred sixty-eight High Plains cabbage acres are treated with methomyl. Thiodicarb and endosulfan were given as alternatives. With thiodicarb as the alternative, growers would lose about $432,000 (89 percent); with endosulfan, they would lose about $322,000 (66 percent).

Diazinon and disulfoton are both applied to 383 acres. If either were lost it would be replaced with esfenvalerate. This would reduce area-wide net returns by an estimated $384,000 (79 percent) in the case of diazinon and $382,000 (78 percent) in the case of disulfoton. A cabbage price increase of 56 percent (from $9.00 to $14.02 per cwt) would be required to make up for the loss of diazinon. Price would need to increase by 55 percent (from $9.00 to $13.98 per cwt) to make up for the loss of disulfoton.

Chlorpyrifos is applied to 94 acres. Endosulfan would replace it, which would reduce area-wide net returns by an estimated $78,000 (16 percent).

Winter Garden

Respondents identified eleven insects as most damaging to cabbage in the Winter Garden. They are: fire ants (100 percent loss if not controlled); broccoli head worms (100 percent); root maggots (100 percent); diamondback moths (96 percent); cabbage loopers (93 percent); flea beetles (79 percent); aphids (75 percent); whiteflies (69 percent); mites (67 percent); root aphids (64 percent); and white grubs (50 percent).

Ten FQPA target insecticides are the primary ones used on cabbage: diazinon (named by 5 respondents); methomyl (4); chlorpyrifos (3); dimethoate (3); methamidophos (3); thiodicarb (3); disulfoton (2); acephate (1); and methyl-parathion (1).

Four non-FQPA target insecticides were selected: endosulfan (1); imidacloprid (1); esfenvalerate (1); lambda-cyhalothrin (1); and permethrin (1).

Winter Garden cabbage growers apply methomyl to 2,813 acres (Table 9). Without it they would use permethrin, spinosad or lambda-cyhalothrin. Area-wide net returns would drop by an estimated $30,000 (1 percent) with permethrin as the alternative, $8,000 with spinosad, and $450 with lambda-cyhalothrin.

Disulfoton is applied to 1,875 acres. Alternatives listed are imidacloprid and permethrin. Losing disulfoton and replacing it with imidacloprid would cost growers an estimated $29,000 (1 percent) in net returns. Estimated loss to net returns would be $27,000 with permethrin as the replacement insecticide.

Fifteen hundred acres of cabbage in the Winter Garden are treated with chlorpyrifos. Either diazinon (also a FQPA target insecticide) or permethrin would be applied in the absence of chlorpyrifos. With diazinon as the alternative, the effect of losing chlorpyrifos would be a loss of about $403,000 (12 percent) in net returns. The loss would be $16,000 with permethrin.

Growers applied thiodicarb to 1,375 acres. Either permethrin or lambda-cyhalothrin would replace it. The impact would be a loss of $528,000 (16 percent) with permethrin as the replacement and $11,000 with lambda-cyhalothrin.

Permethrin or diazinon (also a FQPA targeted insecticide) would replace dimethoate if it were eliminated. Dimethoate is applied to 1,295 acres of cabbage grown in the Winter Garden. The loss of permethrin would cause an estimated $615,000 loss with diazinon as the alternative, and an estimated $380,000 loss with permethrin.

Acephate is used on 1,250 acres. No alternative is available. Therefore, loss of acephate would cost growers an estimated $901,000 (27 percent loss) in net returns.

Diazinon is applied to 875 acres. None, chlorpyrifos (also a FQPA target insecticide), permethrin, and lindane were given as alternatives. With no alternative, growers would lose $383,000 (11 percent) in net returns. The loss would be about $237,000 (7 percent) with chlorpyrifos as the alternative, $625,000 (18 percent) with lindane, and $16,000 with permethrin.

Methyl-parathion is applied to 500 acres and methamidophos to 350 acres. Methyl-parathion would be replaced with permethrin and methamidophos would be replaced with spinosad The estimated area-wide impact of losing methyl-parathion is $14,000; the loss of methamidophos would cost growers $2,000.

Lower Rio Grande Valley

Respondents identified eight insects that cause the most damage to cabbage in the Lower Rio Grande Valley. These insects, and an estimate of percent yield loss if they were uncontrolled, are: beet armyworms (100 percent); cabbage loopers (47 percent); diamondback moths (43 percent); whiteflies (43 percent); root aphids (40 percent); aphids (38 percent); flea beetles (17 percent); and mites (5 percent).

The six FQPA target insecticides primarily used, and the number of people listing them, are: diazinon (3); disulfoton (3); chlorpyrifos (2); methomyl (2); thiodicarb (2); and methamidophos (1).

Six non-FQPA target insecticides also were selected: endosulfan (3); esfenvalerate (3); imidacloprid (3); permethrin (3); cypermethrin (2); and lambda-cyhalothrin (2).

Growers apply diazinon to 2,505 acres in the Lower Rio Grande Valley (Table 10). None, chlorpyrifos and disulfoton (also FQPA target insecticides), and imidacloprid were given as alternatives for diazinon. If no alternative were used, loss of diazinon would cost area cabbage growers about $987,000 (23 percent). The loss is an estimated $1.045 million (24 percent) if chlorpyrifos is used, $1.039 million (24 percent) if disulfoton is used, and $1.201 million (28 percent) if imidacloprid is used.

Thiodicarb is applied to 2,150 acres. Methomyl (also a FQPA target insecticide), *Bacillus thuringiensis*, or tebufenozide would be applied in its absence. Area-wide net returns would decline by an estimated $929,000 (21 percent) with methomyl as the alternative, $1.037 million (24 percent) with *Bacillus thuringiensis*, and $542,000 (12 percent) with tebufenozide.

Eighteen hundred and thirty acres are treated with disulfoton. Chlorpyrifos and diazinon (also FQPA target insecticides) and imidacloprid were given as alternatives. An estimated $794,000 (18 percent) would be lost if disulfoton were withdrawn and chlorpyrifos were applied in its place. The estimated loss would be $810,000 (19 percent) with diazinon as the alternative and $530,000 (12 percent) with imidacloprid.

There are 1,160 acres of cabbage treated with methomyl in the Lower Rio Grande Valley. Alternatives listed were tebufenozide and *Bacillus thuringiensis*. With tebufenozide as the replacement growers would lose an estimated $299,000 (7 percent) in net returns, and with *Bacillus thuringiensis* they would lose about $566,000 (13 percent).

Six hundred thirty acres are treated with chlorpyrifos. Growers said that if chlorpyrifos were not available alternative choices would be none, disulfoton or diazinon (also FQPA target insecticides), or imidacloprid. With none, area growers would lose an estimated $260,000 (6 percent) in net returns. They would lose an estimated $273,000 (6 percent) if they substituted disulfoton, $280,000 (6 percent) with diazinon, and $313,000 (7 percent) with imidacloprid.

Area growers apply methamidophos to 440 acres. They say tebufenozide or imidacloprid would be used to replace it. Replacing it with tebufenozide would cost about $17,000 in net returns area-wide. Using imidacloprid would decrease returns by about $30,000 (1 percent).

All of Texas

Questionnaire results revealed that five FQPA target insecticides--methomyl, disulfoton, thiodicarb, diazinon and chlorpyrifos--are used to control insects in cabbage in all three major growing regions. The estimated number of acres treated in a growing season statewide are: 4,341--methomyl; 4,099--disulfoton; 3,942--thiodicarb; 3,763--diazinon; and 2,224--chlorpyrifos. The estimated losses to statewide net returns if these insecticides were not available (assuming use of the most economical alternatives) are: diazinon--$1.387 million (17 percent loss); disulfoton--$939,000 (11 percent loss); thiodicarb--$921,000 (11 percent loss); methomyl--$732,000 (9 percent loss); and chlorpyrifos--$369,000 (4 percent loss).

Methyl-parathion is applied in the Winter Garden and High Plains areas to an estimated 880 acres. Its loss would reduce statewide net returns by $359,000 (4 percent loss).

Weeds and Herbicides

High Plains

Respondents named three weeds that are most damaging to cabbage in the High Plains: pigweed (80 percent loss if not controlled); kochia (80 percent loss); and grasses (70 percent loss).

No FQPA target herbicides were considered to be primary herbicides used in the High Plains. One respondent selected the non-FQPA target herbicide trifluralin as important.

Since there was no report of FQPA target herbicides used in the High Plains, there is no impact from their withdrawal.

Winter Garden

Respondents named nine weeds that are most damaging to cabbage in this area: pigweed (90 percent loss if not controlled); purslane (84 percent); rag weed (75 percent); sunflower (67 percent); henbit (63 percent); grasses (58 percent); panicum (50 percent); Johnson grass (50 percent); and mustard (50 percent).

Questionnaire respondents listed no FQPA target herbicides as primary herbicides used in the Winter Garden.

Five non-FQPA target herbicides were listed: trifluralin (2 respondents); DCPA (1); paraquat (1); sethoxydim (1); and glyphosate (1).

Since there was no report of FQPA target herbicides used in the Winter Garden, there are no impact from loss estimates.

Lower Rio Grande Valley

Respondents named nine weeds most damaging in the Lower Rio Grande Valley: lambs quarters (100 percent); yellow top (100 percent); sunflower (63 percent); pigweed (60 percent); Colorado grass (60 percent); ground cherry (60 percent); nutsedge (40 percent); London rocket (43 percent); and purslane (20 percent).

Three respondents identified the FQPA target herbicide bensulide as a primary one used in the Lower Rio Grande Valley.

Four non-FQPA target herbicides were listed: DCPA (3 respondents); trifluralin (3); sethoxydim (2); and napropomide (1).

Cabbage growers in the Lower Rio Grande Valley apply bensulide to 4,000 acres in a growing season (Table 10). If bensulide is withdrawn from use, growers would use trifluralin in its place. This change would reduce area-wide net returns by $1.035 million (24 percent).

Diseases and Fungicides

High Plains

Respondents named three diseases most damaging to cabbage in the High Plains: black rot (65 percent loss if not controlled); tip burn (55 percent); and hollow heart (45 percent).

High Plains respondents failed to identify the primary FQPA and non-FQPA target fungicides used on cabbage.

Since there was no report of FQPA target fungicides used in the High Plains, estimates of the impact from loss could not be calculated.

Winter Garden

The seven diseases listed as most damaging, and the estimated percent yield loss if they are not controlled, are: tip burn (72 percent); black rot (68 percent); bacterial soft rot (63 percent); downy mildew (63 percent); Alternaria leaf spot (42 percent); anthracnose (10 percent); and nematode (5 percent).

Five FQPA target fungicides are primary ones used on cabbage in the Texas Winter Garden: chlorothalonil (5 respondents); maneb (3); thiram (2); captan (1); and mancozeb (1).

Three non-FQPA target fungicides were selected: metalaxyl (2 respondents); mefenoxam + copper (1); and metalaxyl + copper (1).

Growers apply chlorothalonil to 3,250 acres of cabbage in the Winter Garden area (Table 9). None, metalaxyl and mefenoxam were given as alternatives in the event chlorothalonil is withdrawn. With no alternative, *real loss* to net returns area wide would be an estimated $3.028 million (90 percent loss), $5.75 million (*total loss*). Area-wide net returns would decrease by an estimated $696,000 (21 percent loss) with mefenoxam as the alternative, but net returns would increase by an estimated $125,000 with metalaxyl as the alternative.

About 750 acres are treated with maneb, for which no alternative was given. Loss of maneb would cost area cabbage growers an estimated $699,000 (21 percent) (*real loss),* $1.166 million (*total loss*).

Lower Rio Grande Valley

Respondents named ten diseases most damaging to cabbage in the Lower Rio Grande Valley. They are: alterneria leaf spot (63 percent loss if not controlled); downy mildew (58 percent); black rot (40 percent); bacterial soft rot (20 percent); southern blight (20 percent); anthracnose (8 percent); tip burn (5 percent); nematode (5 percent); black leg (3 percent); and hollow heart (3 percent).

Four FQPA target fungicides were identified: chlorothalonil (3 respondents); mancozeb (3); maneb (2); and fosetyl-aluminum (2).

Three non-FQPA target fungicides were selected: metalaxyl (2); mefenoxam (1); and mefenoxam + copper (1).

Maneb is applied to 4,300 acres of cabbage grown in the Lower Rio Grande Valley (Table 10). If it were not available, growers would use nothing, chlorothalonil, or fosetyl-aluminum (also FQPA target fungicides) in its place. Area-wide net returns would be reduced by an estimated $1.630 million (37 percent loss) if maneb were not available and no alternative were applied, an estimated $1.729 million (40 percent loss) with fosetyl-aluminum as an alternative, and an estimated $1.870 million (43 percent loss) with chlorothalonil.

Growers use fosetyl-aluminum for disease control on 2,370 acres in the Lower Rio Grande Valley. Respondents said chlorothalonil and maneb (also FQPA target fungicides) and mefenoxam could be used as alternatives. Using chlorothalonil to replace it, area growers would lose $1.028 million (24 percent loss) in net returns. The loss would be $1.027 million (24 percent loss) with maneb as the replacement and $499,000 (11 percent loss) with mefenoxam.

All of Texas

Together, Winter Garden and Lower Rio Grande Valley cabbage growers apply chlorothalonil to an estimated 7,450 acres and maneb to 5,050 acres each growing season. If chlorothalonil were not available for use on cabbage in Texas, it would cost growers an estimated $1.504 million (18 percent loss) in net returns. Loss of maneb would cost $2.328 million (29 percent loss).

Watermelon

In the five major watermelon growing areas, an estimated 103,755 acres of watermelon are harvested annually (Table 1). Five thousand acres are harvested in the High Plains, 4,300 acres in Central Texas, 34,200 acres in East Texas, 7,500 acres in the Winter Garden, and 7,400 in the Lower Rio Grande Valley. Total gross returns for the five areas is estimated at $62.1 million ($3.8 million High Plains, $4.4 million Central Texas, $39 million East Texas, $7.9 million Winter Garden, and $7.1 million Lower Rio Grande Valley). Estimated annual net returns for all five areas is $6.4 million ($625,000 High Plains, $653,000 Central Texas, $3.7 million East Texas, $923,000 Winter Garden, and $518,000 Lower Rio Grande Valley).

Insects and Insecticides

High Plains

Respondents named nine insects as most damaging to watermelon in the High Plains. These insects, and an estimate of percent yield loss if there is no effort made to control them, are: beet armyworms (100 percent); rindworms (60 percent); aphids (58 percent); whiteflies (53 percent); heliothis (40 percent); cucumber beetles (35 percent); squash bugs (20 percent); bollworms (20 percent); and leaf miners (5 percent).

Seven FQPA target insecticides are main ones used in the High Plains: methomyl (8 respondents); dimethoate (3); malathion (3); oxydemeton-methyl (2); azinphos-methyl (1); carbofuran (1); and oxamyl (1).

Five non-FQPA target insecticides were selected by respondents: endosulfan (7); esfenvalerate (3); lindane (1); methoxychlor (1); and permethrin (1).

Watermelon growers in the High Plains apply methomyl to 5,000 acres each growing season (Table 11). Questionnaire respondents gave none, imidacloprid, esfenvalerate, and endosulfan as alternatives for methomyl. Impact on net returns of area growers would be a loss of $625,000 (100 percent loss) (*real loss*), $1.028 million (*total loss*) if no alternative is used. The impact would be an estimated loss of

$625,000 (100 percent loss), (*real loss*), $819,000 (*total loss*) if imidacloprid is used. With endosulfan the loss would be $625,000 (100 percent loss), (*real loss*), $652 thousand (*total loss*). With esfenvalerate it would be $45,000 (7 percent loss).

An estimated 2,500 acres are treated with azinphos-methyl. Endosulfan would replace it if azinphos-methyl were not available. This change would result in an estimated $313,000 loss (50 percent) (*real loss*), $581,000 (*total loss*), in net returns to area growers. A 76 percent increase in watermelon price (from $3.04 to $5.36 per cwt) would be needed to offset the withdrawal of azinphos-methyl.

Growers apply malathion to 2,500 acres of watermelon per growing season. Endosulfan would replace malathion. The *real loss* with this change in products is an estimated $312,000 (50 percent) in area-wide net returns. The *total loss* is $581,000. To make up for the loss, watermelon price would need to increase by 77 percent from $3.04 to $5.37 per cwt.

Methamidophos is applied to 1,750 acres. Growers would depend on endosulfan or imidacloprid if it were lost. If either of these were used, net returns would decrease by $219,000 (35 percent loss) (*real loss*). The *total loss* estimates are $389,000 with endosulfan and $294,000 with imidacloprid.

The FQPA target insecticide dimethoate is applied to 650 acres. According to respondents, either imidacloprid or endosulfan would replace dimethoate if its use is lost. The estimated impact would be a loss of $81,000 (13 percent) (*real loss*), $118 thousand (*total loss*), with imidacloprid, and $9,000 (1 percent) with endosulfan.

Oxydemeton-methyl is applied to 300 acres. Esfenvalerate would be used to replace oxydemeton-methyl if it were banned. This would increase net returns by about $1,000.

Three hundred acres are treated with oxamyl. Without it growers would apply dichloropropene. This would reduce net returns by about $38,000 (6 percent loss) (*real loss*), $90 thousand (*total loss*).

Central Texas

Respondents identified six insects that cause the most damage to watermelon grown in Central Texas. These six insects and an estimate of percent yield loss if there is no effort made to control them are: melon worms (75 percent); squash bug (55 percent); cutworms (50 percent), aphid (38 percent); cucumber beetle (35 percent); and leaf miner (20 percent).

Eight FQPA target insecticides are used on watermelon in Central Texas. They were reported by the number of respondents indicated: methomyl (5); dimethoate (4); carbaryl (3); malathion (2); oxydemeton-methyl (2); azinphos-methyl (1); diazinon (1); and carbofuran (1).

Two non-FQPA target insecticides were selected: endosulfan (4); and esfenvalerate (2).

Carbaryl is applied to 1,560 acres of watermelon in Central Texas (Table 12). If carbaryl is lost esfenvalerate would be used in its place. This change would result in an estimated $23,000 (4 percent) loss in net returns to growers area-wide.

An estimated 1,500 acres of watermelon in Central Texas are treated with dimethoate. Questionnaire respondents listed none and esfenvalerate as alternatives. With no alternative, area-wide net returns would suffer a loss of $228,000 (35 percent) (*real loss*), $244,000 (*total loss*) in a growing season. The impact would be a loss of $228,000 (35 percent) (*real loss*), $347,000 (*total loss*), if esfenvalerate were used as an alternative.

Central Texas watermelon growers apply malathion to 600 acres. Malathion would be replaced with endosulfan. The result would be an increase in net returns to area growers of about $1,000.

Growers apply methomyl to 550 acres. Both none and esfenvalerate were given as alternatives. With no alternative, area-wide net returns would decrease by an estimated $83,000 (13 percent loss) (*real loss*), $179 thousand (*total loss*). The loss would be an estimated $8,000 (1 percent) if esfenvalerate were used as an alternative.

One hundred eighty acres of Central Texas watermelon are treated with oxydemeton-methyl. Endosulfan would be used as an alternative. This could cost area watermelon growers an estimated $27,000 (4 percent loss) (*real loss*), $42,000 (*total loss*).

East Texas

The ten insects that cause the most damage to watermelon grown in East Texas are: melon worms (100 percent loss if not controlled); grasshoppers (100 percent); armyworms (100 percent); rind worms (100 percent), squash bugs (90 percent); vine borers (90 percent); aphids (60 percent); leaf miners (60 percent); whiteflies (60 percent); and cucumber beetles (27 percent).

Ten FQPA target insecticides are used in East Texas: azinphos-methyl (1 respondent); diazinon (1); dimethoate (1); malathion (1); methamidophos (1); oxydemeton-methyl (1); carbaryl (1); carbofuran (1); methomyl (1); and oxamyl (1).

Six non-FQPA target insecticides were selected by respondents: dicofol (1); endosulfan (1); esfenvalerate (1); lindane (1); methoxychlor (1); and permethrin (1).

East Texas watermelon growers apply malathion to 30,400 acres (Table 13). In the absence of malathion growers would use dicofol. This change would result in a loss of about $3.247 million (89 percent) (*real loss*), $6.275 million (*total loss*).

Respondents estimated that East Texas watermelon growers apply carbaryl to 26,600 acres. If carbaryl were not available permethrin would be applied. This change would cost growers $2.84 million (77 percent loss) (*real loss*), $8.2 million (*total loss*), in net returns. Watermelon price would need to increase by 50 percent (from $6.00 to $9.00 per cwt) to make up the loss from the withdrawal of carbaryl.

Diazinon is applied to 26,600 acres of watermelon in East Texas. Diazinon would be replaced with dicofol. The result would be an estimated loss in net returns of $2.84 million (77 percent) (*real loss*), $4.179 million (*total loss*).

An estimated 15,200 acres of watermelon are treated with dimethoate. Growers would apply dicofol if dimethoate became unavailable. With this scenario, area-wide net returns would decline by an estimated $1.623 million (44 percent loss) (*real loss*), $2.717 million (*total loss*) in one growing season.

Growers apply oxydemeton-methyl to an estimated 11,400 acres. Methoxychlor would be applied in the place of oxydemeton-methyl if it were not available. Area-wide net returns would be reduced by an estimated $1.218 million (33 percent) (*real loss*), $3.466 million (*total loss*), if growers lost the use of oxydemeton-methyl and used methoxychlor in its place.

Methomyl is applied to 6,700 acres. The alternative listed by respondents would be dicofol. Using dicofol in place of methomyl would cost area growers an estimated $812,000 (22 percent) (*real loss*), $956,000 (*total loss*), in net returns.

An estimated 3,800 acres of watermelon in East Texas are treated with carbofuran. Endosulfan would replace carbofuran if carbofuran were not available. The estimated impact of losing carbofuran would be a loss of $406,000 (11 percent) (*real loss*), $2.426 million (*total loss*).

Winter Garden

The six insects that cause the most damage to watermelon in the Winter Garden, and an estimate of percent yield loss if there is no effort made to control them, are: cucumber beetles (80 percent); aphids (75 percent); whiteflies (50 percent); squash bugs (25 percent); leaf miners (13 percent); and melon worms (10 percent).

Five FQPA target insecticides were identified as primary ones used on watermelon in the Winter Garden: dimethoate (3); diazinon (2), methomyl (2); methamidophos (1); and carbaryl (1).

Four non-FQPA target insecticides were selected: endosulfan (3); esfenvalerate (2); permethrin (2); and cyromazine (1).

Winter Garden watermelon growers apply methamidophos to 7,500 acres in a growing season (Table 14). Esfenvalerate would be used in place of methamidophos if methamidophos were withdrawn. An estimated $923,000 (100 percent) (*real loss*), $2.755 million (*total loss*), would be lost in area-wide net returns with this change in insect control products. If watermelon price increased by 75 percent from $6.00 to $10.48 per cwt, growers would recover the loss suffered from the withdrawal of methamidophos.

An estimated 5,100 acres of watermelon are treated with methomyl annually. Respondents reported that either no alternative would be used or permethrin or endosulfan would be substituted. With no alternative, area growers would lose an estimated $621,000 (67 percent) (*real loss*), $2.288 million (*total loss*). On the other hand, area net returns would increase by an estimated $43,000 (5 percent) if permethrin were used as an alternative and by an estimated $54,000 (6 percent) if endosulfan were used as an alternative.

Carbaryl is applied to 2,500 acres. Without it growers would use esfenvalerate. This would result in a decline in area net returns of an estimated $10,000 (1 percent loss).

Questionnaire respondents reported that 1,500 acres of Winter Garden watermelon are treated with oxydemeton-methyl. Esfenvalerate would replace oxydemeton. The resulting change in area net returns would be an estimated increase of $5,000 (1 percent).

Dimethoate is applied to 1,100 acres. Endosulfan would be used to replace it, which would lower net returns by an estimated $11,000 (1 percent).

Respondents reported that there is no alternative for diazinon, which is applied to 1,000 watermelon acres in the Winter Garden area. Therefore, the loss of diazinon would cost growers $123,000 (13 percent) (*real loss*), $329 thousand (*total loss*).

Lower Rio Grande Valley

Respondents identified seven insects that cause the most damage to watermelon grown in the Lower Rio Grande Valley: whiteflies (76 percent); leaf miners (47 percent); melon worms (47 percent); aphids (42 percent); cucumber beetles (32 percent); thrips (20 percent); and squash bugs (14 percent).

Ten FQPA target insecticides are primary ones used on watermelon in the Lower Rio Grande Valley: diazinon (4 respondents); methamidophos (4); carbofuran (4); oxamyl (4);

azinphos-methyl (3); dimethoate (3); oxydemeton-methyl (2); carbaryl (2); methomyl (2); and naled (1).

Six non-FQPA target insecticides are used:endosulfan (5); permethrin (5); dicofol (4); esfenvalerate (4); cyromazine (2); and abamectrin (1).

Methomyl is applied to 5,367 acres (Table 15). If methomyl were not available *Bacillus thuringiensis* or permethrin would be used. With either product the *real loss* to growers is estimated to be $376,000 (73 percent loss). *Total loss* is estimated at $1.336 million with *Bacillus thuringiensis* and $609,000 with permethrin.

Watermelon growers apply oxamyl to 5,000 acres and said that there is no alternative. The impact of losing oxamyl is estimated to be $138,000 (27 percent) and $612,000 for *real loss* and *total loss, respectively*.

An estimated 4,050 acres of watermelon are treated with diazinon. Respondents gave none and imidacloprid as alternatives to diazinon. With no alternative or with imidacloprid applied in the place of diazinon, area growers would lose an estimated $284,000 (55 percent) (*real loss*) in net returns. The *total loss* with no alternative is estimated at $1.299 million, and at $787,000 with imidacloprid as an alternative.

The FQPA target insecticide dimethoate is applied to 2,750 acres. If dimethoate is withdrawn, imidacloprid would be used in its place. This change would reduce area-wide net returns by an estimated $193,000 (37 percent) (*real loss*) or $1.072 million (*total loss*).

According to questionnaire respondents, carbofuran is applied to 2,030 acres. They report there is no alternative. In the absence of carbofuran, area-wide net returns would decline by an estimated $142,000 (27 percent) (*real loss*) or $658,000 (*total loss*).

Azinphos-methyl is applied to 1,700 acres. If it were unavailable, *Bacillus thuringiensis,* permethrin or cyromazine would be applied. With any of these three substitutes the loss in net returns would be $119,000 (23 percent) (*real loss*). *Total loss* estimates are $227,000 with *Bacillus thuringiensis*, $223,000 with permethrin, and $608 with cyromazine.

Six hundred fifty acres are treated with methamidophos. None and imidacloprid were given as alternatives to methamidophos. The *real loss* would be about $46,000 (9 percent) with either none or imidacloprid as alternatives. Estimates of *total loss* are $199,000 with no alternative and $226,000 with imidacloprid as the alternative.

All of Texas

Methomyl and dimethoate are used to control insects on watermelon in all five of the major growing areas. State wide, methomyl is applied to 23,617 acres and dimethoate to 21,200 acres. If methomyl is lost, watermelon growers would lose an estimated $1.186 million in net returns (19 percent); they would lose $2.063 million (32 percent) if dimethoate is lost.

Oxydemeton-methyl is used in four of the major growing areas and applied to an estimated 13,380 acres statewide. Its loss would reduce net returns for the state’s watermelon growers by $1.239 million (19 percent).

Methamidophos, malathion, carbaryl and diazinon are all used in at least three of the major growing areas. Methamidophos is applied to 9,900 acres, malathion to 33,500 acres, carbaryl to 30,660 acres, and diazinon to 31,650 acres. Loss of methamidophos would cost growers an estimated $1.187 million (19 percent of total net returns); loss of malathion would cost growers $3.558 million (56 percent of total net returns); loss of carbaryl would cost $2.873 million (45 percent of total net returns);

and loss of diazinon would cost growers $3.247 million (51 percent of total net returns).

Growers in two of the major watermelon growing areas apply oxamyl, carbofuran and azinphos-methyl to control insects in their crops. They treat 5,300 acres with oxamyl, 5,830 acres with carbofuran, and 4,200 acres with azinphos-methyl. If oxamyl were not available, net returns for watermelon growers statewide would decline by an estimated $175,000 (3 percent). Net returns would be reduced by $548,000 (9 percent) without carbofuran and $432,000 (7 percent) without azinphos-methyl.

Weeds and Herbicides

High Plains

These are the 17 weeds identified as most harmful and an estimate of percent yield loss if they were not controlled: pigweed (53 percent); catbur (50 percent); iron weed (50 percent); kochia (50 percent); cocklebur (50 percent); grasses (50 percent); thistle (47 percent); sunflower (40 percent); tumbleweed (40 percent); Johnson grass (38 percent); morning glory (35 percent); night shade (35 percent); white weed (30 percent); nutgrass (30 percent); barnyard grass (25 percent); Texas blue weed (15 percent); and Bermuda grass (1 percent).

Five respondents reported that the FQPA target herbicide bensulide is a primary one used on watermelon in the High Plains. Four non-FQPA target herbicides also were listed: trifluralin (7 respondents); naptalam (3); sethoxydim (3); and glyphosate (2).

Bensulide is applied to 2,750 acres of watermelon in the Texas High Plains (Table 11). In its absence growers would apply trifluralin, DCPA or naptalam. Loss of bensulide would reduce area-wide net returns by $344,000 (55 percent loss) (*real loss*) with any of the three replacements. The *total loss* would be $405,000, $803,000, or $544 with trifluralin, DCPA or naptalam, respectively.

Central Texas

Estimates of lost yield with the eight weeds that cause the most damage to watermelon in Central Texas are: nutsedge (60 percent); crabgrass (60 percent); Texas panicum (50 percent); pigweed (50 percent); barnyard grass (30 percent); Johnson grass (70 percent); purslane (30 percent); and morning glory (30 percent).

Four questionnaire respondents reported that the FQPA target herbicide bensulide is a primary herbicide used on watermelon in Central Texas. Five non-FQPA target herbicides were selected also: trifluralin (3 respondents); naptalam (2); sethoxydim (2); DCPA (1); and glyphosate (1).

Central Texas watermelon growers apply bensulide to 1,000 acres (Table 12). None and trifluralin were given as alternatives. With no alternative, growers would lose an estimated $150,000 (23 percent loss). However, it was estimated that if trifluralin were applied in place of bensulide, area net returns would increase by an estimated $27,000.

East Texas

East Texas weeds and an estimate of percent yield loss if they are not controlled are: Texas panicum (100 percent); crab grass (100 percent); Bermuda grass (80 percent); Johnson grass (70 percent); nutsedge (50 percent); wild croton (50 percent); goose grass (45 percent); pigweed (40 percent); chickweed (40 percent); sand burs (30 percent); bull nettles (30 percent); and barnyard grass (30 percent).

The FQPA target herbicide bensulide and five non-FQPA target herbicides (naptalam, DCPA, sethoxydim, glyphosate and trifluralin) were selected by one respondent each as primary herbicides used.

An estimated 17,100 acres are treated with bensulide by East Texas watermelon growers (Table 13). DCPA would be used to replace bensulide if bensulide were withdrawn. With this change, East Texas growers would lose an estimated $1.779 million (49 percent) in reduced net returns.

Winter Garden

Respondents identified seven weeds as causing the most damage to watermelon grown in the Winter Garden. They are: field grass (50 percent); pigweed (50 percent); sunflower (40 percent); nut grass (35 percent); Johnson grass (25 percent); Texas panicum (18 percent); and nutsedge (25 percent).

One respondent reported that the FQPA target herbicide, bensulide is a primary herbicide used. Three non-FQPA target herbicides were selected by respondents: trifluralin (3); naptalam (2); and sethoxydim (2).

Winter Garden watermelon growers apply bensulide to 5,000 acres to control weeds (Table 14). Respondents reported that there is no alternative. Therefore, if bensulide were not available watermelon growers would lose an estimated $615,000 (67 percent) (*real loss*), $1.701 million (*total loss*). Watermelon price would need to increase by 68 percent (from $6.00 to $10.10 per cwt) to make up the loss.

Lower Rio Grande Valley

The weeds identified as most harmful and an estimate of percent yield loss if uncontrolled are: pigweed (66 percent); purslane (60 percent); Johnson grass (60 percent); lambs quarter (60 percent); prostrate spurge (60 percent); grasses (60 percent); nutsedge (53 percent); sunflower (53 percent); thistle (50 percent); yellow top (47 percent); Colorado grass (47 percent); and mustard (40 percent).

Five respondents reported that the FQPA target herbicide bensulide is a primary one used. Three non-FQPA target herbicides also were selected by respondents as primary herbicides used. They are: naptalam (4); sethoxydim (4); trifluralin (4); paraquat (3); and glyphosate (3).

Bensulide is applied to 4,150 acres of watermelon in the Lower Rio Grande Valley (Table 15). According to questionnaire respondents there is not a suitable replacement for bensulide. Its loss would cost area growers an estimated $291,000 (56 percent) *(real loss*), $1.286 million (*total loss*). A 74 percent increase in watermelon price (from $6.00 to $10.43 per cwt) would be required to offset the loss from withdrawal of bensulide.

All of Texas

Bensulide is applied to control weeds in all five major watermelon growing areas. An estimated 30,000 acres are treated with bensulide annually. Its loss would lower net returns by $3.002 million (47 percent) (*real loss*), $5.144 million (81 percent) (*total loss*).

Diseases and Fungicides

High Plains

Respondents named eleven diseases most damaging to watermelon in the High Plains: powdery mildew (70 percent loss if not controlled); downy mildew (65 percent); Fusarium wilt (65 percent); anthracnose (62 percent); nematode (60 percent); vine declines (50 percent); bacterial fruit blotch (43 percent);

viruses (42 percent); Alternaria (35 percent); Cercospora (15 percent); and gummy stem blight (10 percent).

The four FQPA target fungicides identified as primary ones used are: chlorothalonil (8 respondents); mancozeb (7); maneb (6); and benomyl (5).

The five non-FQPA target fungicides listed are: copper (6); triadimefon (5); mefenoxam (3); thiophanate methyl (2); and copper + zinc (2).

High Plains watermelon growers apply chlorothalonil to 5,000 acres each growing season (Table 11). If chlorothalonil were not available their options include none, azoxystrobin, thiophanate methyl or sulfur. Replacing chlorothalonil with any of these alternatives would mean a loss of about $625,000 (100 percent) (*real loss*). The *total loss* in net returns would be an estimated $1.047 million if no alternative is used, $927,000 if thiophanate methyl is used, $1.045 million if Triadimefon is used, $743,000 if sulfur is used, and $638,000 if azoxystrobin is used.

An estimated 5,000 acres are treated with mancozeb each growing season. Respondents said the best alternatives are none, azoxystrobin, copper and mefenoxam. With any of these alternatives, loss of mancozeb would reduce area-wide net returns by $625,000 (100 percent loss) (*real loss*). The *total loss* is estimated to be $969,000 if no alternative is used, $1.144 million with azoxystrobin, $1.103 million with copper, and $1.073 million with mefenoxam.

It was reported that benomyl is applied to 2,750 acres. Five responses were given as to what would be the next best alternative if benomyl were not available. They are none, azoxystrobin, thiophanate- methyl, triadimefon and sulfur. Replacing benomyl with any of these except thiophanate-methyl would result in a loss of about $344,000 (55 percent) (*real loss*) in net returns. Replacing benomyl with thiophanate-methyl would increase area-wide net returns by $37,000. The *total loss* of replacing benomyl with none, azoxystrobin, triadimefon or sulfur is estimated at $802,000, $443,000, $667,000 or $501,000, respectively.

Maneb is applied to 1,500 acres. If not available, alternatives would be none, azoxystrobin or mefenoxam. If no alternative were applied area-wide net returns would be reduced by an estimated $113,000 (18 percent loss). The loss would be $188,000 (30 percent) (*real loss*) if maneb were replaced with either azoxystrobin or mefenoxam. The estimated *real loss* would be $268,000 with azoxystrobin and $324,000 with mefenoxam.

Central Texas

Diseases most damaging in Central Texas and an estimate of percent yield loss if they are not controlled are: cercospora (100 percent); anthracnose (78 percent); viruses (63 percent); Alternaria (50 percent); gummy stem blight (50 percent); downy mildew (45 percent); vine declines (43 percent); and Fusarium wilt (5 percent).

FQPA target fungicides identified as primary fungicides used on watermelon in Central Texas are: chlorothalonil (5 respondents); mancozeb (3); benomyl (3); captan (1); and maneb (1).

Non-FQPA target fungicides listed are: thiophanate methyl (3); copper + zinc (1); and copper (1).

Chlorothalonil is applied to 3,750 acres (Table 12). Alternatives listed were none and thiophanate-methyl. Either alternative would cost growers an estimated $569,000 (87 percent loss) (*real loss*) in net returns. The *total loss* is estimated to be $1.931 million with no alternative and $1.159 million with thiophanate-methyl. An increase in watermelon price from $6.33 to $10.19 per cwt (61 percent) would needed to offset the loss resulting from withdrawal of chlorothalonil.

An estimated 1,100 acres are treated with mancozeb, and there are no suitable substitutes. Without mancozeb area-wide net returns would decline by $167,000 (26 percent loss) (*real loss*), and $170,000 (*total loss*).

Central Texas watermelon growers apply benomyl to 550 acres. Thiophanate-methyl would be the best alternative. Making this change would cost growers $83,000 (13 percent) (*real loss*) and $115 thousand (*total loss*).

East Texas

Respondents named ten diseases most damaging to watermelon in East Texas: viruses (100 percent loss if not controlled); anthracnose (100 percent); powdery mildew (100 percent); vine declines (90 percent); gummy stem blight (90 percent); Fusarium wilt (85 percent); downy mildew (85 percent); nematode (80 percent); Alternaria (70 percent); and Cercospora (40 percent).

Four FQPA target fungicides are important to watermelon crops in Central Texas: chlorothalonil (2 respondents); benomyl (2); mancozeb (1); and maneb (1).

Four non-FQPA target fungicides also are used: mefenoxam (1); thiophanate methyl (1); copper (1); and sulfur (1).

East Texas watermelon growers apply chlorothalonil to 34,200 acres (Table 13). In its absence triadimefon or sulfur would be applied. With triadimefon replacing chlorothalonil the impact on area-wide net returns would be a loss of $743,000 (20 percent). With sulfur there would be a gain of $276,000 (8 percent) in net returns.

Mancozeb is applied to 7,600 acres and it would be replaced with thiophanate-methyl. This would result in a loss of about $812,000 (22 percent) (*real loss*), $1.114 million (*total loss*).

Benomyl and maneb both are applied to 3,800 acres. Sulfur would be used to replace either. Replacing benomyl with sulfur would bring a gain of $112,000 (3 percent) in area-wide net returns. Replacing maneb with sulfur would cost growers $176,000 (5 percent) in lost net returns.

Winter Garden

The ten diseases most damaging to watermelon in the Winter Garden, and an estimate of percent yield loss if they are not controlled, are: bacterial fruit blotch (100 percent); downy mildew (63 percent); viruses (60 percent); powdery mildew (26 percent); nematode (19 percent); Cercospora (10 percent); gummy stem blight (10 percent); Fusarium wilt (8 percent); anthracnose (5 percent); and Alternaria (5 percent).

Four FQPA target fungicides were identified as primary fungicides used on watermelon in the Winter Garden: chlorothalonil (3 respondents); mancozeb (3); maneb (1); and thiram (1).

Four non-FQPA target fungicides were selected: copper + zinc (2); copper (2); mefenoxam (1); and metalaxyl (1).

Chlorothalonil is applied to 6,500 acres (Table 14). If chlorothalonil were not available growers would either not apply an alternative fungicide or they would apply copper. With either choice growers would lose an estimated $800,000 (87 percent) (*real loss*). The *total loss* would be $1.944 million with no alternative and $2.938 million with copper. A watermelon price increase of 130 percent (from $6.00 to $13.79 per cwt) would be needed to offset the loss in net returns if chlorothalonil were not available and copper were used in its place.

Mancozeb is applied to 5,000 acres of watermelon in the Winter Garden. If mancozeb were not available growers would apply copper. This would reduce area-wide net returns by an estimated $677,000 (73 percent) (*real loss*), $2.302 million (*total loss*). Watermelon price would have to increase by 97 percent to cover this loss.

Lower Rio Grande Valley

Respondents named ten diseases that are most damaging to watermelon in the Lower Rio Grande Valley. They are listed with an estimate of percent yield loss if not controlled: viruses (88 percent); downy mildew (65 percent); Alternaria (48 percent); gummy stem blight (46 percent); anthracnose (40 percent); vine declines (35 percent); nematode (34 percent); powdery mildew (29 percent); Cercospora (27 percent); and Fusarium wilt (13 percent).

Six FQPA target fungicides were identified as primary ones used on watermelon in the Winter Garden: chlorothalonil (5 respondents); mancozeb (5); maneb (4); benomyl (3); captan (1); and thiram (1).

Five non-FQPA target fungicides were selected: mefenoxam (4); sulfur (4); triadimefon (3); copper (3); and copper + zinc (1).

Questionnaire respondents reported that watermelon growers in the Lower Rio Grande Valley apply mancozeb to 7,000 acres per growing season (Table 15). They gave none and azoxystrobin as alternatives to mancozeb. If no alternative were applied growers in the area would lose an estimated $490,000 (95 percent) (*real loss*), $2.166 million (*total loss*). The loss would be $315,000 (61 percent) with azoxystrobin as the alternative.

Approximately 6,000 acres are treated with chlorothalonil. If chlorothalonil were not available, growers would either apply no alternative or they would use azoxystroin. Either alternative would result in a reduction in area-wide net returns of $420,000 (81 percent loss) (*real loss*). The *total loss* for not applying an alternative is estimated to be $1.873 million, and the *total loss* with azoxystrobin is estimated at $504,000.

Maneb is applied to 5,000 acres. None and azoxystrobin were given as alternatives. Using no alternative treatment would decrease net returns by about $350,000 (68 percent loss) (*real loss*), $1.608 million (*total loss*). Using azoxystrobin as an alternative would cause growers to lose $285,000 (55 percent loss).

All of Texas

Both chlorothalonil and mancozeb are used to control diseases in watermelon in all five of the major growing areas. Statewide, chlorothalonil is applied to 55,450 acres and mancozeb to 26,200 acres. If chlorothalonil is lost, watermelon growers would lose an estimated $2.137 million in net returns (34 percent); they would lose $2.595 million (41 percent) if mancozeb is lost.

All Study Crops Combined

Insecticides

Eighteen different FQPA target insecticides are used among the four study crops (Table 16). Diazinon and methomyl are the only ones used on all four crops. Diazinon, carbaryl, methomyl, malathion and dimethoate are all used on more than 20,000 acres. Diazinon is used on 46,826 acres. Considering all four study crops together, growers would suffer the greatest economic loss from the withdrawal of diazinon ($8.6 million in lost net returns, or 17 percent) (Tables 17 and 18). If any of six other FQPA target pesticides (phorate, malathion, carbaryl, disulfoton, dimethoate and methomyl) is withdrawn, net returns from the four study areas would be reduced by more than $2 million.

Herbicides

Three FQPA target herbicides are used to control weeds in the study crops. Bensulide is used in cabbage and watermelon (34,000 acres treated) (Table 16). EPTC (7,963 acres treated) and metribuzin (14,483 acres treated) are used to control weeds in potatoes. Respondents reported that bensulide and metolachlor-metribuzin are used on onions, but did not supply enough data to report the number of acres treated or to estimate the economic impact of losing the use of these herbicides. An estimated $4 million (8 percent of statewide net returns for the four study crops) would be lost if bensulide is withdrawn; $3 million (6 percent of statewide net returns) would be lost if EPTC is withdrawn (Tables 17 and 18).

Fungicides

Ten different fungicides are applied to the study crops statewide (Table 16). Chlorothalonil and maneb are applied to all four corps. Chlorothalonil is applied to an estimated 100,000 acres, mancozeb to 61,000, and maneb to 41,000. Loss of mancozeb would cost growers an estimated $18 million (36 percent of statewide net returns for the four study crops); $17 million (34 percent of statewide net returns) would be lost if chlorothalonil is withdrawn; and $14 million (28 percent of statewide net returns) would be lost if mancozeb were no longer available (Tables 17 and 18).

PESTICIDE APPLICATION RATES

The Environmental Protection Agency (EPA) conducts risk assessments to determine potential pesticide risk**s** to human health and the environment. In their preliminary risk assessments conducted under FQPA, EPA made the assumption that pesticides were applied at the highest label rate allowable. This assumption greatly exaggerated the amount of pesticides being applied and resulted in inaccurate risk estimates. EPA needs to use actual application rates so that risk assessments conform more closely with reality.

Questionnaire respondents reported common pesticide application rates used for the study crops, most of which were lower, and sometimes much lower, than the highest allowable label rate (Tables 19, 20, 21 and 22). For potatoes, the highest allowable label rate was 300 percent higher than the actual rate used for four pesticides--disulfoton (DiSyston® 8E), oxamyl (Vydate® L), pendimethalin (Prowl® 3.3EC), and ethoprop (Mocap® granular 10%). Only two of the 28 pesticides reported on, mancozeb (Dithane® M-45) and chlorothalonil (Bravo® Ultrex), had an actual rate as high as the highest allowable label rate.

Onion growers reported their most common rates for 24 pesticides (Table 20). The highest allowable label rate for the herbicide glyphosate (Roundup®) is 567 percent higher than the actual rate growers use. The allowable rate for the fungicide dicloran (Botran® 75-W) is 385 percent higher than the actual rate. It was 100 percent or more higher for six other pesticides. The rate respondents said they use was equal to the highest allowable label rate for only one pesticide--copper sulfate (Top Cop®), a fungicide.

Cabbage growers reported the most common rates used for 21 pesticides (Table 21). The highest allowable label rate for methyl parathion 4E is 300 percent higher than the actual rate given by respondents. The highest allowable label rate for Diazinon AG500 is 220 percent higher than that reported by respondents. Four other pesticides had highest allowable label rates 100 percent or more greater than the rates applied by growers. They were chlorpyrifos (Lorsban® 4E), Diazinon 14G, imidacloprid (Admire® 2F), and fosetyl-aluminum (Aliette®). Respondents reported applying the highest allowable label rates for malathion 5EC, lambda-cyhalothrin (Karate® 1E), and maneb 75DF. In three cases--chlorothalonil (Bravo® 720), disulfoton (DiSyston® 8E), and maneb (Manex ® FL)--the rate growers reported using was higher than the highest allowable label rate (25 percent, 6 percent and 3 percent higher, respectively).

Respondents to the watermelon questionnaire supplied application rates for 26 different pesticides (Table 22). The highest allowable label rate of sulfur is 200 percent higher than the actual rate growers use. The highest allowable label rate was 100 percent or more higher than the actual rates for six other pesticides: methomyl (Lannate® LV); carbaryl (Sevin® 4F); oxamyl (Vydate® L); naptalam (Alanap-L®); chlorothalonil (Bravo® 720); and mancozeb (Dithane® M-45). Respondents reported using the highest allowable label rate of triadimefon (Bayleton® 50% DF) and a rate 14 percent higher than the highest allowable label rate for benomyl (Benlate®).

NEW PESTICIDES

Questionnaire respondents were asked to identify any new pesticides that might become available for use on the study crops and supply other information they might have about the pests the new products would control, the efficacy of the new pesticides, and the time when the new pesticide might be available. Nineteen different pesticides were identified (Table 23). Azoxystrobin (Quadris), a fungicide, was listed most frequently--by six watermelon growers, three onion growers, and three cabbage growers. In all, watermelon growers listed four insecticides, three fungicides, one fungicide/miticide/insecticide, and one herbicide. Cabbage growers listed seven insecticides and one fungicide. Onion growers listed two insecticides and one fungicide. Potato growers listed two fungicides.

RESPONDENTS' COMMENTS

Questionnaire respondents were asked to write any comments or other information that might be helpful in assessing the impact of losing the use of FQPA target pesticides. Most frequently mentioned was the need to maintain fungicides for disease control, and it was pointed out that insect control is also important to reduce the plant stress that contributes to disease (Appendix B). Several respondents said that the study crops would not be grown if FQPA target pesticides were lost. Loss of the broad spectrum fungicides chlorothalonil and mancozeb would be particularly devastating, resulting in 100 percent crop loss. Potatoes are subject to severe late blight infestation on average every 3 years; if not controlled 100 percent of the crop could be lost. Without soil insecticides such as diazinon, crop loss could be 80 percent. Yield would be reduced by 50 to 60 percent if aphids are not controlled in watermelon. There are only a few pesticides registered for use in vegetable crops; eliminating any would reduce growers' ability to combat pests, and with fewer pesticides available for rotation, pest resistance rates would surely increase. Losses due to the cancellation of any or all FQPA target pesticides could be offset only if there were new pesticides that were both economical and had efficacies equal to or better than the old pesticides. The pesticides FQPA is targeting are needed to help growers supply market demand with sufficient quantity and quality. If the quality is not up to the high standards the market demands, the products will not sell. If loss of FQPA target pesticides makes producing vegetable crops in Texas unprofitable, more production will shift to Mexico and elsewhere and we will be required to import more in order to meet U. S. consumer demand. For the most part, alternatives to FQPA target pesticides are more expensive. The FQPA target pesticides are controlling pests well. Overall use of pesticides would increase if FQPA target pesticides are lost.

Growers are careful with pesticides. They comply with label directions and apply pesticides only when needed. Many watermelon growers use plastic mulch to control weeds and reduce their dependence on pesticides. Growers are also attentive to using pesticides safely and to applying them in a way that prevents damage to beneficial insects.

SUMMARY

Sixty experts responded to questionnaires and supplied information about their use of pesticides in potatoes, onions, cabbage and watermelon produced in Texas. Information was supplied for all four crops in three growing regions--the High Plains, the Winter Garden, and the Lower Rio Grande Valley (Figure 1). Watermelon data also was obtained from Central and East Texas. Primary data (questionnaire responses) and secondary data (see Data Sources) were used to estimate the economic impact of the Food Quality Protection Act (FQPA) on production in Texas of the four study crops.

Combined, around 103,750 acres of potatoes, onions, cabbage and watermelon are harvested in Texas annually. Total gross farm receipts from these four crops is $220 million annually.

The questionnaire respondents listed the most damaging pests and estimated the percent yield loss that would occur if each pest were not controlled. A total of 35 insects, 49 weeds and 31 diseases were listed for the four study crops. Insects listed most often were: aphids (49 percent yield loss if present and not controlled); whiteflies (59 percent); and leaf miners (25 percent). Pigweed (63 percent yield loss), sunflower (57 percent), and Johnson grass (46 percent) were the most frequently mentioned weeds. Diseases reported most often were downy mildew (64 percent yield loss) and nematodes (29 percent).

There are 82 pesticides currently registered for use in the four study crops and recommended by the Texas Agricultural Extension Service (Appendix A). Nearly half (38) are FQPA target pesticides. Questionnaire respondents reported that 32 of these are pesticides they rely on most heavily, along with 32 non-FQPA target pesticides.

Diazinon and methomyl are the most common FQPA target insecticides reported used on all four crops and in all five growing regions (watermelon is the only crop reported on in two of the growing regions). The leading non-FQPA target insecticides used are endosulfan, permethrin and esfenvalerate. The FQPA target herbicide bensulide is used on onions, cabbage and watermelon, and in all the growing regions. The predominant non-FQPA herbicides used are sethoxydim and trifluralin. Chlorothalonil, mancozeb and maneb are the most popular FQPA target fungicides used on the study crops.

Chlorothalonil and mancozeb are used on all the crops and in all the growing regions. Maneb is used on all the crops but cabbage and in all the areas. The main non-FQPA target fungicides used are copper and mefenoxam.

COMMENTS

The accuracy of this study depends on the accuracy of the data used. When more concrete data were not available it was necessary to rely on expert opinion. Economic impact estimates are limited to the change in net returns resulting from the withdrawal of one pesticide in one growing area in one crop. In our model only the yield and cost of pesticide treatments are allowed to change. All other variables are held constant. The estimates reported here apply only to the first growing season following the removal of the pesticides. Long-term effects are not addressed. There are national models that can be used with the major crops to predict changes in cropping patterns, crop prices, employment, consumer prices, intra-state and international trade, etc. These models are scarce for the minor crops, however. This is a Texas study only and no attempt was made to estimate dynamic changes. Nevertheless, assuming the results of this study are indicative of the effect that losing FQPA target pesticides would have on other crops in other areas, it is apparent there could be a huge disruption in national agricultural production and domestic food and fiber supply.

The fate of FQPA target pesticides is unknown at this time. This study assumes the total withdrawal of the particular FQPA target pesticide in question. This may not happen. The uses of some of them may not change; others may be relabeled for fewer uses, lower rates, and/or fewer applications per season. Some pesticides may be phased out rather than withdrawn all at once. New pesticides and other pest control methods are being developed that will replace some of the current practices. This study does not address the transition from current practices to full implementation of FQPA and how to maintain an ample supply of safe, high quality agricultural products during this transition period. Such a study could be very useful to those who will make these crucial decisions.

Table 1. Estimates of Selected Economic Variables for Potatoes, Onions, Cabbage, and Watermelon Produced in Texas by Production Region.

Crop/ Region	Price/ cwt	Yield/ acre (cwt)	Gross returns/ acre	Harvest cost/ cwt	Pre-harvest var. costs/ acre	Total variable costs/ acre	Net returns/ acre	Acres Harvested	Total gross returns	Total net returns
Potatoes										
High Plains	10.00	325	3,253	4.86	668	2,248	1,003	9,000	29,250,000	9,022,500
Winter Garden	10.00	225	2,250	4.85	704	1,795	455	11,750	26,437,500	5,343,313
Lower Rio Grande Valley	10.00	210	2,100	4.86	668	1,689	411	3,000	6,300,000	1,234,200
Totals								23,750	61,987,500	15,600,013
Onions										
High Plains	12.93	350	4,526	9.26	814	4,055	471	750	3,394,125	352,875
Winter Garden	14.70	375	5,513	8.33	564	3,688	1,825	3,150	17,364,375	5,747,963
Lower Rio Grande Valley	16.60	250	4,150	7.30	877	2,702	1,448	9,350	38,802,500	13,538,800
Totals								13,250	59,561,000	19,639,638
Cabbage										
High Plains	9.00	400	3,600	4.00	852	2,452	1,148	425	1,530,000	487,900
Winter Garden	11.60	388	4,501	6.91	888	3,569	932	3,630	16,337,904	3,382,144
Lower Rio Grande Valley	11.60	367	4,257	6.91	707	3,243	1,014	4,300	18,305,960	4,361,189
Totals								8,355	36,173,864	8,231,233

Table 1. Estimates of Selected Economic Variables for Potatoes, Onions, Cabbage, and Watermelon Produced in Texas by Production Region (continued).

Crop/ Region	Price/ cwt	Yield/ acre (cwt)	Gross returns/ acre	Harvest cost/ cwt	Pre-harvest var. costs/ acre	Total variable costs/ acre	Net returns/ acre	Acres Harvested	Total gross returns	Total net returns
Watermelon										
High Plains	3.04	250	760	1.56	245	635	125	5,000	38,000,000	625,000
Central Texas	6.33	160	1,013	1.75	581	861	152	4,300	4,355,040	652,740
East Texas	6.00	190	1,140	2.38	581	1,033	107	34,200	38,988,000	3,652,560
Winter Garden	6.00	175	1,050	2	577	927	123	7,500	7,875,000	922,500
Lower Rio Grande Valley	6.00	160	960	2.25	530	890	70	7,400	7,104,000	518,000
Total								58,400	62,122,040	6,370,800
Totals all crops								103,755	219,844,404	49,841,683

Table 2. **Potatoes - Texas High Plains**; Selected Results of Study of Potential Economic Impact of FQPA on Texas Vegetables. (Assuming the FQPA target pesticide is withdrawn and the alternative pesticide is applied in its place)

FQPA target pesticide	Alternative pesticide	FQPA target pesticide cost/acre	Alternative pesticide cost/acre	Percent change in yield	Change in net returns/ acre	Acres treated with FQPA target pesticide	Regional change in net returns
Ethoprop	Dichloropropene	49.50	199.50	-8	-279	4,500	-1,253,250
Metribuzin	none	33.00	0.00	0	33	4,500	148,500
Phorate	Disyston*	30.00	21.00	-15	-248	3,375	-837,000
Disulfoton	Phorate*	21.00	30.00	-15	-266	3,375	-897,750
Chlorothalonil	Cymoxanil	48.36	28.07	-23	-365	9,000	-3,286,920
Chlorothalonil	Dimethomorph	48.36	129.40	-23	-467	9,000	-4,198,833
Mancozeb	Cymoxanil	52.20	12.48	-23	-346	9,000	-3,111,996
Propamocarb	Cymoxanil	85.95	18.72	-38	-575	9,000	-5,177,393
Propamocarb	Dimethomorph	85.95	86.27	-38	-643	9,000	-5,785,335
Captan	Fludioxonil	68.59	6.05	-8	-66	7,650	-504,594
Captan	Thiophanate-methyl	68.59	36.80	-8	-97	7,650	-739,832

*FQPA targeted pesticide also.

Table 3. **Potatoes - Texas Winter Garden**; Selected Results of Study of Potential Economic Impact of FQPA on Texas Vegetables. (Assuming the FQPA target pesticide is withdrawn and the alternative pesticide is applied in its place)

FQPA target pesticide	Alternative pesticide	FQPA target pesticide cost/acre	Alternative pesticide cost/acre	Percent change in yield	Change in net returns/ acre (*real*)[1]	Acres treated with FQPA target pesticide	Regional change in net returns (*real*)	Change in net returns/ acre (*total*)[2]	Regional change in net returns (*total*)
Phorate	Disulfoton*	24.30	24.74	-38	-443	11,400	-5,054,105		
Phorate	Imidacloprid	24.30	59.19	-38	-455	11,400	-5,184,150	-480	-5,475,455
Methamidophos	Methomyl*	29.57	52.29	-16	-208	3,233	-672,849		
Methamidophos	Imidacloprid	29.57	53.99	-13	-174	3,233	-561,799		
Oxamyl	None	58.25	0	-22	-199	1,495	-297,879		
Oxamyl	Phorate*	58.25	24.30	+10	152	1,495	227,838		
Metribuzin	Pendimethalin	18.65	7.22	-14	-153	9,983	-1,531,031		
EPTC	None	34.69	0	-44	-455	7,963	-3,621,174	-475	-3,783,699
EPTC	Metolachlor	34.69	20.51	-33	-372	7,963	-2,962,774		
Chlorothalonil	None	72.75	0	-50	-455	11,750	-5,343,313	-504	-5,922,588
Chlorothalonil	Triphenyltin hydroxide	72.75	23.25	-20	-218	11,750	-2,613,240		
Mancozeb	None	58.23	0	-22	-274	11,000	-2,873,850		
Mancozeb	Chlorothalonil*	58.23	75.36	-6	-89	11,000	-981,478		
Mancozeb	Mefenoxam	58.23	73.50	-20	-247	11,000	-2,717,220		

Table 3. **Potatoes - Texas Winter Garden**; Selected Results of Study of Potential Economic Impact of FQPA on Texas Vegetables. (Assuming the FQPA target pesticide is withdrawn and the alternative pesticide is applied in its place) (continued)

FQPA target pesticide	Alternative pesticide	FQPA target pesticide cost/acre	Alternative pesticide cost/acre	Percent change in yield	Change in net returns/ acre (*real*)[1]	Acres treated with FQPA target pesticide	Regional change in net returns (*real*)	Change in net returns/ acre (*total*)[2]	Regional change in net returns (*total*)
Maneb	Triphenyltin hydroxide	12.68	23.25	-22	-242	11,000	-2,665,520		
Propamocarb	None	56.30	0	-28	-268	3,493	-936,648		
Propamocarb	Triphenyltin hydroxide	56.30	23.25	-20	-199	3,493	-694,059		

[*]FQPA targeted pesticide also.

[1]In some cases the estimated change in net returns per acre (net returns with the alternative pesticide minus net returns with the FQPA target pesticide) was greater (in absolute value) than net returns per acre with the FQPA target pesticide. In such cases assuming the change is a negative value, growers would lose more than 100% of expected net returns. The term (*real*) refers to the estimates where the change in net returns per acre(in absolute value) is less than or equal to net returns per acre with the FQPA target pesticide. This would be the greatest expected real loss resulting from the withdrawal of the FQPA target pesticide since growers would not continue to operate where expected net returns are negative.

[2]The term (*total*) gives the estimates where the change in net returns per acre is negative and greater (in absolute value) than net returns per acre with the FQPA target pesticide. It is assumed that growers would discontinue production before suffering losses this great.

Table 4. **Potatoes - Texas Lower Rio Grande Valley**; Selected Results of Study of Potential Economic Impact of FQPA on Texas Vegetables. (Assuming the FQPA target pesticide is withdrawn and the alternative pesticide is applied in its place)

FQPA target pesticide	Alternative pesticide	FQPA target pesticide cost/acre	Alternative pesticide cost/acre	Percent change in yield	Change in net returns/ acre (*real*)[1]	Acres treated with FQPA target pesticide	Regional change in net returns (*real*)	Change in net returns/ acre (*total*)[2]	Regional change in net returns (*total*)
Diazinon	Imidacloprid	62.12	130.61	-20	-284	1,740	-494,800		
Methomyl	Esfenvalerate	31.88	24.47	-20	-208	1,305	-227,062		
Methamidophos	Endosulfan	29.50	27.01	-35	-373	NA	NA		
Methamidophos	Imidacloprid	29.50	53.99	-35	-400	NA	NA		
Mancozeb	None	49.44	0	-60	-411	2,900	-1,193,060	-598	-1,734,780
Mancozeb	Dimethomorph	49.44	84.77	-35	-411	2,900	-1,193,060		
Maneb	None	50.00	0	-66	-411	2,900	-1,193,060	-644	-1,926,934
Iprodione	None	118.95	0	-60	-411	2,900	-1,193,060	-529	-1,533,190
Propamocarb	None	84.45	0	-66	-411	2,900	-1,193,060	-630	-1,827,029
Propamocarb	Dimethomorph	84.45	84.77	-35	-376	2,900	-1,089,052		
Chlorothalonil	None	65.00	0	-60	-411	2,175	-894,795	-583	-1,267,242
Chlorothalonil	Cymoxanil	65.00	11.48	-35	-322	2,175	-699,698		
Captan	Fludioxonil	60.04	5.55	-35	-321	NA	NA		

[1]In some cases the estimated change in net returns per acre (net returns with the alternative pesticide minus net returns with the FQPA target pesticide) was greater (in absolute value) than net returns per acre with the FQPA target pesticide. In such cases assuming the change is a negative value, growers would lose more than 100% of expected net returns. The term (*real*) refers to the estimates where the change in net returns per acre (in absolute value) is less than or equal to net returns per acre with the FQPA target pesticide. This would be the greatest expected real loss resulting from the withdrawal of the FQPA target pesticide since growers would not continue to operate where expected net returns are negative.
[2]The term (*total*) gives the estimates where the change in net returns per acre is negative and greater (in absolute value) than net returns per acre with the FQPA target pesticide. It is assumed that growers would discontinue production before suffering losses this great.

Table 5. **Onions - Texas High Plains**; Selected Results of Study of Potential Economic Impact of FQPA on Texas Vegetables. (Assuming the FQPA target pesticide is withdrawn and the alternative pesticide is applied in its place)

FQPA target pesticide	Alternative pesticide	FQPA target pesticide cost/acre	Alternative pesticide cost/acre	Percent change in yield	Change in net returns/ acre	Acres treated with FQPA target pesticide	Regional change in net returns
Methyl-parathion	Methomyl*	13.78	49.31	-14	-215	590	-127,064
Methyl-parathion	Oxamyl*	13.78	22.70	-14	-189	590	-111,364
Methyl-parathion	Imidacloprid	13.78	51.21	-14	-217	590	-128,183
Methyl-parathion	Cypermethrin	13.78	48.46	-13	-200	590	-117,901
Methomyl	Cypermethrin	40.36	41.54	0	-1	405	-478
Methomyl	Lambda-cyhalothrin	40.36	12.78	0	28	405	11,168
Methomyl	Methyl-parathion*	40.36	18.80	-14	-158	405	-64,099
Methomyl	Oxamyl*	40.36	22.70	-14	-162	405	-65,680
Methomyl	Imidacloprid	40.36	51.21	-14	-188	405	-76,264
Oxamyl	Cypermethrin	18.33	41.54	0	-23	23	-534
Oxamyl	Lambda-cyhalothrin	18.33	12.78	0	6	23	128
Oxamyl	Methomyl*	18.33	49.31	-14	-211	23	-4,849
Oxamyl	Methyl-parathion*	18.33	18.8	-14	-180	23	-4,147
Oxamyl	Imidacloprid	18.33	51.21	-14	-213	23	-4,892
Mancozeb	Chlorothalonil*	13.23	34.07	-14	-201	725	-145,486
Mancozeb	Iprodione*	13.23	26.45	-14	-193	725	-139,961
Chlorothalonil	Iprodione*	34.07	26.45	-14	-172	725	-124,850

Table 5. **Onions - Texas High Plains**; Selected Results of Study of Potential Economic Impact of FQPA on Texas Vegetables. (Assuming the FQPA target pesticide is withdrawn and the alternative pesticide is applied in its place) (continued)

FQPA target pesticide	Alternative pesticide	FQPA target pesticide cost/acre	Alternative pesticide cost/acre	Percent change in yield	Change in net returns/ acre	Acres treated with FQPA target pesticide	Regional change in net returns
Dichloropropene	None	12.53	0	-14	-167	363	-14,221
Iprodione	Chlorothalonil*	26.45	34.07	-14	-187	109	-20,432
Iprodione	Mancozeb*	26.45	13.23	-14	-167	109	-18,160

*FQPA targeted pesticide also.

Table 6. **Onions - Texas Winter Garden**; Selected Results of Study of Potential Economic Impact of FQPA on Texas Vegetables. (Assuming the FQPA target pesticide is withdrawn and the alternative pesticide is applied in its place)

FQPA target pesticide	Alternative pesticide	FQPA target pesticide cost/acre	Alternative pesticide cost/acre	Percent change in yield	Change in net returns/ acre	Acres treated with FQPA target pesticide	Regional change in net returns
Methomyl	Cypermethrin	31.14	17.77	-15	-343	2,250	-772,538
Methomyl	Permethrin	31.14	12.37	-30	-695	2,250	-1,563,008
Methomyl	Lambda-cyhalothrin	31.14	17.68	-15	-343	2,250	-772,328
Oxamyl	Cypermethrin	20.23	17.77	0	2	2,125	5,228
Oxamyl	Lambda-cyhalothrin	20.23	23.50	0	-3	2,125	-7,098
Diazinon	None	10.77	0	-27	-633	1,575	-996,353
Diazinon	Chlorpyrifos*	10.77	15.42	-10	-240	1,575	-478,319
Diazinon	Cypermethrin	10.77	10.71	0	>1	1,575	87
Diazinon	Permethrin	10.77	14.85	0	-4	1,575	-6,434
Chlorpyrifos	None	15.42	0	-20	-462	1,500	-693,495
Chlorpyrifos	Diazinon*	15.42	18.03	-10	-238	1,500	357,450
Chlorpyrifos	Lambda-cyhalothrin	15.42	9.96	0	5	1,500	8,187
Chlorothalonil	None	56.98	0	-50	-1,134	3,150	-3,572,762
Chlorothalonil	Iprodione*	56.98	106.02	0	-49	3,150	-154,475
Chlorothalonil	Fosetyl-aluminum*	56.98	52.91	0	4	3,150	12,813
Chlorothalonil	Mancozeb*	56.98	27.1	-20	-448	3,150	-1,410,791

Table 6. **Onions - Texas Winter Garden**; Selected Results of Study of Potential Economic Impact of FQPA on Texas Vegetables. (Assuming the FQPA target pesticide is withdrawn and the alternative pesticide is applied in its place) (continued)

FQPA target pesticide	Alternative pesticide	FQPA target pesticide cost/acre	Alternative pesticide cost/acre	Percent change in yield	Change in net returns/ acre	Acres treated with FQPA target pesticide	Regional change in net returns
Chlorothalonil	Metalaxyl	56.98	26.49	-20	-447	3,150	-1,408,861
Chlorothalonil	Thiophanate-methyl	56.98	308.58	-20	-729	3,150	-2,297,453
Chlorothalonil	Copper	56.98	30.96	-25	-573	3,150	-1,804,194
Mancozeb	Fosetyl-aluminum*	20.40	57.84	0	-37	2,615	-97,906
Mancozeb	Chlorothalonil*/ Metalaxyl	20.40	74.59	-20	-532	2,615	-1,391,023
Mancozeb	Copper + Sulfur	20.40	20.75	-20	-478	2,615	-1,250,232
Maneb	Chlorothalonil*	24.60	56.98	0	-32	2,363	-76,514
Maneb	Copper	24.60	23.22	-25	-597	2,363	-1,411,656
Iprodione	None	64.78	0	-50	-1,126	2,000	-2,252,820
Iprodione	Fosetyl-aluminum	64.78	64.20	0	1	2,000	1,170
Iprodione	Vinclozolin	64.78	46.12	-20	-459	2,000	-918,180
Iprodione	Copper	64.78	7.74	-25	-542	2,000	-1,083,480
Iprodione	Chlorothalonil*	64.78	53.48	0	11	2,000	22,595
Thiram	None	0.12	0	-47	-1,121	1,800	-2,017,800
Captan	None	0.66	0	-40	-955	800	-763,872

*FQPA targeted pesticide also.

Table 7. **Onions - Texas Lower Rio Grande Valley**; Selected Results of Study of Potential Economic Impact of FQPA on Texas Vegetables. (Assuming the FQPA target pesticide is withdrawn and the alternative pesticide is applied in its place)

FQPA target pesticide	Alternative pesticide	FQPA target pesticide cost/acre	Alternative pesticide cost/acre	Percent change in yield	Change in net returns/ acre (*real*)[1]	Acres treated with FQPA target pesticide	Regional change in net returns (*real*)	Change in net returns/ acre (*total*)[2]	Regional change in net returns (*total*)
azinphos-methyl	Permethrin	13.89	10.81	NA	NA	8,800	NA		
Methomyl	None	25.91	0	-23	-504	8,225	-4,146,963		
Methomyl	Diazinon*	25.91	47.59	-16	-394	8,225	-3,238,018		
Methomyl	Methyl parathion*	25.91	7.27	-16	-353	8,225	-2,906,386		
Methomyl	Oxamyl*	25.91	18.56	-16	-365	8,225	-2,999,246		
Methomyl	Lambda-cyhalothrin	25.91	108.07	0	-82	8,225	-675,766		
Methomyl	Cypermethrin	25.91	66.06	0	-40	8,225	-330,247		
Methomyl	Permethrin	25.91	59.56	-10	-266	8,225	-2,188,220		
Diazinon	None	33.06	0	-20	-432	8,098	-3,497,850		
Diazinon	Cypermethrin	33.06	12.01	NA	NA	8,098	NA		
Oxamyl	None	18.56	0	-22	-493	2,653	-1,307,763		
Oxamyl	Diazinon*	18.56	47.59	-16	-401	2,653	-1,063,926		
Oxamyl	Methyl parathion*	18.56	7.27	-16	-361	2,653	-956,957		
Oxamyl	Methomyl*	18.56	25.43	-16	-379	2,653	-1,005,135		

Table 7. **Onions - Texas Lower Rio Grande Valley**; Selected Results of Study of Potential Economic Impact of FQPA on Texas Vegetables. (Assuming the FQPA target pesticide is withdrawn and the alternative pesticide is applied in its place) (continued)

FQPA target pesticide	Alternative pesticide	FQPA target pesticide cost/acre	Alternative pesticide cost/acre	Percent change in yield	Change in net returns/ acre (*real*)[1]	Acres treated with FQPA target pesticide	Regional change in net returns (*real*)	Change in net returns/ acre (*total*)[2]	Regional change in net returns (*total*)
Methyl parathion	Diazinon*	7.27	47.59	-16	-412	1,012	-417,272		
Methyl parathion	Methomyl*	7.27	25.43	-16	-394	1,012	-394,846		
Methyl parathion	Oxamyl*	7.27	18.56	-16	-387	1,012	-387,986		
Bensulide	None	19.82	0	NA	NA	8,800	NA		
Chlorpyrifos	None	15.92	0	-44	-1,007	900	-906,372		
Chlorothalonil	None	92.78	0	-59	-1,274	9,350	-11,914,892		
Chlorothalonil	Sulfur	92.78	54.60	-80	-1,448	9,350	-13,538,800	-1,822	-17,034,017
Chlorothalonil	Iprodione	92.78	158.61	-31	-782	9,350	-7,310,999		
Chlorothalonil	Maneb*	92.78	66.95	-31	-690	9,350	-6,454,025		
Chlorothalonil	Thiophanate methyl	92.78	308.58	NA	NA	9,350	NA		
Maneb	Sulfur	63.29	45.50	-80	-1,448	9,250	-13,394,000	-1,842	-17,040,443
Maneb	Iprodione*	63.29	158.61	-31	-811	9,250	-7,505,589		
Maneb	Chlorothalonil*	63.29	89.60	-31	-742	9,250	-6,867,293		

Table 7. **Onions - Texas Lower Rio Grande Valley**; Selected Results of Study of Potential Economic Impact of FQPA on Texas Vegetables. (Assuming the FQPA target pesticide is withdrawn and the alternative pesticide is applied in its place) (continued)

FQPA target pesticide	Alternative pesticide	FQPA target pesticide cost/acre	Alternative pesticide cost/acre	Percent change in yield	Change in net returns/ acre (*real*)[1]	Acres treated with FQPA target pesticide	Regional change in net returns (*real*)	Change in net returns/ acre (*total*)[2]	Regional change in net returns (*total*)
Mancozeb	None	51.86	0	-49	-1,083	9,000	-9,744,657		
Mancozeb	Fosetyl-aluminum*	51.86	57.84	NA	NA	9,000	NA		
Thiram	NA	0.12	NA	NA	NA	9,000	NA		
Iprodione	None	118.95	0	-64	-1,369	8,900	-12,184,511		
Iprodione	Dicloran	118.95	129.20	-51	-1,191	8,900	-10,603,019		
Iprodione	Sulfur	118.95	27.30	-80	-1448	8,900	-12,887,200	-1,768	-15,738,281
Iprodione	Chlorothalonil*	118.95	89.60	-31	-687	8,900	-6,112,041		
Iprodione	Maneb*	118.95	66.95	-31	-664	8,900	-5,910,456		
Iprodione	Metalaxyl	118.95	33.28	-20	-379	8,900	-3,376,003		

*FQPA targeted pesticide also.

[1]In some cases the estimated change in net returns per acre (net returns with the alternative pesticide minus net returns with the FQPA target pesticide) was greater (in absolute value) than net returns per acre with the FQPA target pesticide. In such cases assuming the change is a negative value, growers would lose more than 100% of expected net returns. The term (*real*) refers to the estimates where the change in net returns per acre(in absolute value) is less than or equal to net returns per acre with the FQPA target pesticide. This would be the greatest expected real loss resulting from the withdrawal of the FQPA target pesticide since growers would not continue to operate where expected net returns are negative.

[2]The term (*total*) gives the estimates where the change in net returns per acre is negative and greater (in absolute value) than net returns per acre with the FQPA target pesticide. It is assumed that growers would discontinue production before suffering losses this great.

Table 8. **Cabbage - Texas High Plains**; Selected Results of Study of Potential Economic Impact of FQPA on Texas Vegetables. (Assuming the FQPA target pesticide is withdrawn and the alternative pesticide is applied in its place)

FQPA target pesticide	Alternative pesticide	FQPA target pesticide cost/acre	Alternative pesticide cost/acre	Percent change in yield	Change in net returns/ acre	Acres treated with FQPA target pesticide	Regional change in net returns
Carbaryl	None	31.09	0	-38	-719	417	-299,787
Thiodicarb	Bacillus thuringiensis	35.00	44.50	-44	-885	417	-368,837
Diazinon	Esfenvalerate	12.92	16.02	-50	-1,003	383	-384,184
Disulfoton	Esfenvalerate	19.48	16.02	-50	-997	383	-381,674
Methyl- parathion	Malathion*	12.27	21.03	-59	-1,180	380	-448,400
Methyl-parathion	Bacillus thuringiensis	12.27	44.50	-44	-907	380	-344,747
Methomyl	Thiodicarb*	39.99	35.00	-59	-1,175	368	-432,404
Methomyl	Endosulfan	39.99	38.88	-44	-874	368	-321,592
Chlorpyrifos	Endosulfan	7.48	14.00	-41	-827	94	-77,693

*FQPA targeted pesticide also.

Table 9. **Cabbage - Texas Winter Garden**; Selected Results of Study of Potential Economic Impact of FQPA on Texas Vegetables. (Assuming the FQPA target pesticide is withdrawn and the alternative pesticide is applied in its place)

FQPA target pesticide	Alternative pesticide	FQPA target pesticide cost/acre	Alternative pesticide cost/acre	Percent change in yield	Change in net returns/ acre	Acres treated with FQPA target pesticide	Regional change in net returns
Methomyl	Permethrin	25.41	35.97	0	-11	2,813	-29,705
Methomyl	Lambda-cyhalothrin	25.41	25.57	0	<-1	2,813	-450
Methomyl	Spinosad	25.41	28.35	0	-3	2,813	-8,270
Disulfoton	Imidacloprid	21.47	37.11	0	-16	1,875	-29,325
Disulfoton	Permethrin	21.47	36.54	0	-15	1,875	-27,188
Chlorpyrifos	Diazinon*	14.93	11.77	-15	-269	1,500	-403,283
Chlorpyrifos	Permethrin	14.93	35.97	0	-21	1,500	-31,565
Thiodicarb	Permethrin	17.50	35.97	-20	-384	1,375	-528,399
Thiodicarb	Lambda-cyhalothrin	17.50	25.57	0	-8	1,375	-11,096
Thiodicarb	Spinosad	17.50	28.35	-7	-137	1,375	-189,035
Dimethoate	Permethrin	10.74	70.04	-13	-294	1,295	-380,466
Dimethoate	Diazinon*	10.74	30.80	-25	-475	1,295	-615,112
Dimethoate	Lambda-cyhalothrin	10.74	40.84	-40	-757	1,295	-980,380
Acephate	None	6.51	0	-40	-720	1,250	-900,555

Table 9. **Cabbage - Texas Winter Garden**; Selected Results of Study of Potential Economic Impact of FQPA on Texas Vegetables. (Assuming the FQPA target pesticide is withdrawn and the alternative pesticide is applied in its place) (continued)

FQPA target pesticide	Alternative pesticide	FQPA target pesticide cost/acre	Alternative pesticide cost/acre	Percent change in yield	Change in net returns/ acre (*real*)[1]	Acres treated with FQPA target pesticide	Regional change in net returns (*real*)	Change in net returns/ acre (*total*)[2]	Regional change in net returns (*total*)
Diazinon	None	17.75	0	-25	-437	875	-382,533		
Diazinon	Chlorpyrifos[*]	17.75	16.42	-15	-271	875	-236,854		
Diazinon	Lindane	17.75	4.53	-40	-714	875	-624,514		
Diazinon	Permethrin	17.75	20.25	0	-18	875	-15,943		
Methyl-parathion	Permethrin	7.77	35.97	0	-28	500	-14,103		
Methamidophos	Spinosad	22.72	28.35	0	-6	350	-1,971		
Chlorothalonil	None	50.51	0	-100	-932	3,250	-3,028,090	-1,769	-5,749,933
Chlorothalonil	Metalaxyl	50.51	11.60	0	39	3,250	125,288		
Chlorothalonil	Mefenoxam	50.51	106.5	-20	-557	3,250	-695,840		
Thiram	None	0.06	0	-27	-492	2,100	-1,034,009		
Maneb	None	16.26	0	-65	-932	750	-698,790	-1,166	-874,215

[*]FQPA targeted pesticide also.

[1]In some cases the estimated change in net returns per acre (net returns with the alternative pesticide minus net returns with the FQPA target pesticide) was greater (in absolute value) than net returns per acre with the FQPA target pesticide. In such cases assuming the change is a negative value, growers would lose more than 100% of expected net returns. The term (*real*) refers to the estimates where the change in net returns per acre(in absolute value) is less than or equal to net returns per acre with the FQPA target pesticide. This would be the greatest expected real loss resulting from the withdrawal of the FQPA target pesticide since growers would not continue to operate where expected net returns are negative.

[2]The term (*total*) gives the estimates where the change in net returns per acre is negative and greater (in absolute value) than net returns per acre with the FQPA target pesticide. It is assumed that growers would discontinue production before suffering losses this great.

Table 10. **Cabbage - Texas Lower Rio Grande Valley**; Selected Results of Study of Potential Economic Impact of FQPA on Texas Vegetables. (Assuming the FQPA target pesticide is withdrawn and the alternative pesticide is applied in its place)

FQPA target pesticide	Alternative pesticide	FQPA target pesticide cost/acre	Alternative pesticide cost/acre	Percent change in yield	Change in net returns/ acre	Acres treated with FQPA target pesticide	Regional change in net returns
Diazinon	None	37.53	0	-25	-394	2,505	-1,044,710
Diazinon	Chlorpyrifos*	37.53	23.1	-25	-417	2,505	-986,845
Diazinon	Disulfoton*	37.53	20.97	-25	-415	2,505	-1,039,375
Diazinon	Imidacloprid	37.53	85.52	-25	-479	2,505	-1,201,072
Thiodicarb	Tebufenozide	25.50	52.25	-13	-252	2,150	-541,520
Thiodicarb	Bacillus thuringiensis	25.50	76.25	-25	-482	2,150	-1,036,795
Thiodicarb	Methomyl*	25.50	25.91	-25	-432	2,150	-928,542
Disulfoton	Imidacloprid	20.79	85.52	-13	-290	1,830	-530,096
Disulfoton	Chlorpyrifos*	20.79	23.1	-25	-434	1,830	-793,506
Disulfoton	Diazinon*	20.79	31.95	-25	-442	1,830	-809,702
Methomyl	Tebufenozide	19.43	52.25	-13	-258	1,160	-299,211
Methomyl	Bacillus thuringiensis	19.43	76.25	-25	-488	1,160	-566,428
Chlorpyrifos	None	19.51	0	-25	-412	630	-259,541
Chlorpyrifos	Disulfoton*	19.51	20.97	-25	-444	630	-279,670
Chlorpyrifos	Diazinon*	19.95	31.95	-25	-433	630	-272,752
Chlorpyrifos	Imidacloprid	19.51	85.52	-25	-497	630	-313,419
Bensulide	Trifluralin	26.41	7.06	-16	-259	4,000	-1,034,720

Table 10. **Cabbage - Texas Lower Rio Grande Valley**; Selected Results of Study of Potential Economic Impact of FQPA on Texas Vegetables. (Assuming the FQPA target pesticide is withdrawn and the alternative pesticide is applied in its place) (continued)

FQPA target pesticide	Alternative pesticide	FQPA target pesticide cost/acre	Alternative pesticide cost/acre	Percent change in yield	Change in net returns/ acre	Acres treated with FQPA target pesticide	Regional change in net returns
Maneb	None	52.49	0	-25	-379	4,300	-1,629,657
Maneb	Chlorothalonil*	52.49	56	-25	-435	4,300	-1,870,457
Maneb	Fosetyl-aluminum*	52.49	23.07	-25	-402	4,300	-1,728,858
Chlorothalonil	None	43.55	0	-25	-388	4,200	-1,629,306
Chlorothalonil	Fosetyl-aluminum*	43.55	23.07	-25	-411	4,200	-1,726,200
Chlorothalonil	Maneb*	43.25	55.44	-25	-443	4,200	-1,862,154
Fosetyl-aluminum	Mefenoxam*	53.66	161	-6	-211	2,370	-498,932
Fosetyl-aluminum	Chlorothalonil*	53.66	56	-25	-434	2,370	-1,028,153
Fosetyl-aluminum	Maneb*	53.66	55.44	-25	-433	2,370	-1,026,826
Methamidophos	Tebufenozide	17.56	57	0	-39	440	-17,307
Methamidophos	Imidacloprid	17.56	85.52	0	-68	440	-29,856

*FQPA targeted pesticide also.

Table 11. **Watermelon - Texas High Plains**; Selected Results of Study of Potential Economic Impact of FQPA on Texas Vegetables. (Assuming the FQPA target pesticide is withdrawn and the alternative pesticide is applied in its place)

FQPA target pesticide	Alternative pesticide	FQPA target pesticide cost/acre	Alternative pesticide cost/acre	Percent change in yield	Change in net returns/ acre (*real*)[1]	Acres treated with FQPA target pesticide	Regional change in net returns (*real*)	Change in net returns/ acre (*total*)[2]	Regional change in net returns (*total*)
Methomyl	None	26.69	0	-63	-125	5,000	-625,000	-206	-1,028,350
Methomyl	Imidacloprid	26.69	32.13	-43	-125	5,000	-625,000	-164	-818,975
Methomyl	Esfenvalerate	26.69	35.72	0	-9	5,000	-45,150		
Methomyl	Endosulfan	26.69	13.5	-39	-125	5,000	-625,000	-130	-651,860
Azinphos-methyl	Endosulfan	11.91	22.6	-60	-125	2,500	-312,500	-232	-580,973
Malathion	Endosulfan	11.52	22.3	-60	-125	2,500	-312,500	-233	-581,951
Methamidophos	Imidacloprid	22.22	32.13	-43	-125	1,750	-218,750	-168	-294,473
Methamidophos	Endosulfan	22.22	22.3	-60	-125	1,750	-218,750	-222	-388,640
Dimethoate	Imidacloprid	9.05	32.13	-43	-125	650	-81,250	-181	-117,936
Dimethoate	Endosulfan	9.05	22.3	0	-13	650	-8,613		
Oxydemeton-methyl	Esfenvalerate	16.42	11.90	0	5	300	1,354		
Oxamyl	Dichloropropene	77.40	153.80	-60	-125	300	-37,500	-298	-89,522

Table 11. **Watermelon - Texas High Plains**; Selected Results of Study of Potential Economic Impact of FQPA on Texas Vegetables. (Assuming the FQPA target pesticide is withdrawn and the alternative pesticide is applied in its place) (continued)

FQPA target pesticide	Alternative pesticide	FQPA target pesticide cost/acre	Alternative pesticide cost/acre	Percent change in yield	Change in net returns/ acre (*real*)[1]	Acres treated with FQPA target pesticide	Regional change in net returns (*real*)	Change in net returns/ acre (*total*)[2]	Regional change in net returns (*total*)
Bensulide	Trifluralin	19.82	8.59	-43	-125	2,750	-343,750	-147	-404,608
Bensulide	DCPA	19.82	90	-60	-125	2,750	-343,750	-292	-803,495
Bensulide	Naptalam	19.82	32.5	-50	-125	2,750	-343,750	-198	-543,620
Chlorothalonil	None	67.31	0	-75	-125	5,000	-625,000	-209	-1,047,250
Chlorothalonil	Azoxystroin	67.13	36.48	-43	-125	5,000	-625,000	-128	-637,650
Chlorothalonil	Thiophanate methyl	67.13	30.63	-60	-125	5,000	-625,000	-185	-926,600
Chlorothalonil	Triadimefon	67.13	91.22	-50	-125	5,000	-625,000	-209	-1,044,500
Chlorothalonil	Sulfur	67.13	31	-50	-125	5,000	-625,000	-149	-743,450
Mancozeb	None	17.88	0	-57	-125	5,000	-625,000	-194	-968,800
Mancozeb	Azoxystroin	17.88	36.48	-57	-125	5,000	-625,000	-229	-1,143,800
Mancozeb	Copper	17.88	16.48	-60	-125	5,000	-625,000	-221	-1,103,000
Mancozeb	Mefenoxam	17.88	47.48	-50	-125	5,000	-625,000	-215	-1,073,000

Table 11. **Watermelon - Texas High Plains**; Selected Results of Study of Potential Economic Impact of FQPA on Texas Vegetables. (Assuming the FQPA target pesticide is withdrawn and the alternative pesticide is applied in its place) (continued)

FQPA target pesticide	Alternative pesticide	FQPA target pesticide cost/acre	Alternative pesticide cost/acre	Percent change in yield	Change in net returns/ acre (*real*)[1]	Acres treated with FQPA target pesticide	Regional change in net returns (*real*)	Change in net returns/ acre (*total*)[2]	Regional change in net returns (*total*)
Benomyl	None	33.84	0	-88	-125	2,750	-343,750	292	802,340
Benomyl	Azoxystroin	33.84	36.48	-43	-125	2,750	-343,750	-161	-442,750
Benomyl	Thiophanate methyl	33.84	20.42	0	13	2,750	36,905		
Benomyl	Triadimefon	33.84	91.22	-50	-125	2,750	-343,750	-242	-666,545
Benomyl	Sulfur	33.84	31	-50	-125	2,750	-343,750	-182	-500,940
Benomyl	Sulfur	33.84	31	-50	-125	2,750	-343,750	-182	-500,940
Maneb	None	10.94	0	-25	-76	1,500	-113,355		
Maneb	Azoxystroin	10.94	36.48	-43	-125	1,500	-187,500	-179	-267,975
Maneb	Mefenoxam	10.94	47.48	-50	-125	1,500	-187,500	-216	-324,435

[1]In some cases the estimated change in net returns per acre (net returns with the alternative pesticide minus net returns with the FQPA target pesticide) was greater (in absolute value) than net returns per acre with the FQPA target pesticide. In such cases assuming the change is a negative value, growers would lose more than 100% of expected net returns. The term (*real*) refers to the estimates where the change in net returns per acre(in absolute value) is less than or equal to net returns per acre with the FQPA target pesticide. This would be the greatest expected real loss resulting from the withdrawal of the FQPA target pesticide since growers would not continue to operate where expected net returns are negative.

[2]The term (*total*) gives the estimates where the change in net returns per acre is negative and greater (in absolute value) than net returns per acre with the FQPA target pesticide. It is assumed that growers would discontinue production before suffering losses this great.

Table 12. **Watermelon - Central Texas**; Selected Results of Study of Potential Economic Impact of FQPA on Texas Vegetables. (Assuming the FQPA target pesticide is withdrawn and the alternative pesticide is applied in its place)

FQPA target pesticide	Alternative pesticide	FQPA target pesticide cost/acre	Alternative pesticide cost/acre	Percent change in yield	Change in net returns/ acre (*real*)[1]	Acres treated with FQPA target pesticide	Regional change in net returns (*real*)	Change in net returns/ acre (*total*)[2]	Regional change in net returns (*total*)
Carbaryl	Esfenvalerate	8.88	53.58	0	-15	1,560	-22,780		
Dimethoate	None	11.08	0	-24	-152	1,500	-227,700	-163	-244,440
Dimethoate	Endosulfan	11.08	11.13	-33	-152	1,500	-227,700	-232	-347,490
Methomyl	None	12.95	0	-46	-152	550	-83,490	-326	-179,282
Methomyl	Esfenvalerate	26.23	53.58	0	-14	550	-7,743		
Malathion	Endosulfan	8.51	6.3	0	2	600	1,330		
Oxydemeton-methyl	Endosulfan	16.42	6.3	-33	-152	180	-27,324	-233	-41,871
Bensulide	None	33.00	0	-25	-150	1,000	-150,201		
Bensulide	Trifluralin	33.00	6.3	0	27	1,000	26,704		
Chlorothalonil	None	57.44	0	-78	-152	3,750	-569,250	-515	-1,931,475
Chlorothalonil	Thiophanate-methyl	57.44	66.35	-50	-152	3,750	-569,250	-309	-1,158,600
Mancozeb	None	19.90	0	-24	-152	1,100	-166,980	-154	-169,551
Benomyl	Thiophanate-methyl	19.86	45.46	-25	-152	550	-83,490	-209	-114,842

[1]In some cases the estimated change in net returns per acre (net returns with the alternative pesticide minus net returns with the FQPA target pesticide) was greater (in absolute value) than net returns per acre with the FQPA target pesticide. In such cases assuming the change is a negative value, growers would lose more than 100% of expected net returns. The term (*real*) refers to the estimates where the change in net returns per acre(in absolute value) is less than or equal to net returns per acre with the FQPA target pesticide. This would be the greatest expected real loss resulting from the withdrawal of the FQPA target pesticide since growers would not continue to operate where expected net returns are negative.
[2]The term (*total*) gives the estimates where the change in net returns per acre is negative and greater (in absolute value) than net returns per acre with the FQPA target pesticide. It is assumed that growers would discontinue production before suffering losses this great.

Table 13. **Watermelon - East Texas**; Selected Results of Study of Potential Economic Impact of FQPA on Texas Vegetables. (Assuming the FQPA target pesticide is withdrawn and the alternative pesticide is applied in its place)

FQPA target pesticide	Alternative pesticide	FQPA target pesticide cost/acre	Alternative pesticide cost/acre	Percent change in yield	Change in net returns/ acre (*real*)[1]	Acres treated with FQPA target pesticide	Regional change in net returns (*real*)	Change in net returns/ acre (*total*)[2]	Regional change in net returns (*total*)
Malathion	Dicofol	39.61	46.91	-29	-107	30,400	-3,246,720	-206	-6,274,712
Carbaryl	Permethrin	28.84	22.19	-46	-107	26,600	-2,840,880	-308	-8,200,348
Diazinon	Dicofol	44.33	31.28	-25	-107	26,600	-2,840,880	-157	-4,178,594
Dimethoate	Dicofol	7.05	15.64	-25	-107	15,200	-1,623,360	-179	-2,716,613
Oxydemeton-methyl	Methoxychlor	16.42	5.52	-46	-107	11,400	-1,217,520	-304	-3,466,106
Methomyl	Dicofol	12.95	15.64	-18	-107	7,600	-811,680	-126	-955,809
Carbofuran	Endosulfan	13.33	11.13	-93	-107	3,800	-405,840	-639	-2,426,440
Bensulide	DCPA	33.00	90.00	-7	-104	17,100	-1,779,447		
Chlorothalonil	Triadimefon	39.08	60.81	0	-22	34,200	-743,166		
Chlorothalonil	Sulfur	39.08	31.00	0	8	34,200	276,336		
Mancozeb	Thiophanate-methyl	32.10	33.85	-21	-107	7,600	-811,680	-147	-1,113,804
Benomyl	Sulfur	10.71	7.75	0	3	3,800	112,432		
Maneb	Sulfur	10.88	15.50	0	-5	3,800	-175,560		

[1]In some cases the estimated change in net returns per acre (net returns with the alternative pesticide minus net returns with the FQPA target pesticide) was greater (in absolute value) than net returns per acre with the FQPA target pesticide. In such cases assuming the change is a negative value, growers would lose more than 100% of expected net returns. The term (*real*) refers to the estimates where the change in net returns per acre(in absolute value) is less than or equal to net returns per acre with the FQPA target pesticide. This would be the greatest expected real loss resulting from the withdrawal of the FQPA target pesticide since growers would not continue to operate where expected net returns are negative.

[2]The term (*total*) gives the estimates where the change in net returns per acre is negative and greater (in absolute value) than net returns per acre with the FQPA target pesticide. It is assumed that growers would discontinue production before suffering losses this great.

Table 14. **Watermelon - Texas Winter Garden**; Selected Results of Study of Potential Economic Impact of FQPA on Texas Vegetables. (Assuming the FQPA target pesticide is withdrawn and the alternative pesticide is applied in its place)

FQPA target pesticide	Alternative pesticide	FQPA target pesticide cost/acre	Alternative pesticide cost/acre	Percent change in yield	Change in net returns/ acre (*real*)[1]	Acres treated with FQPA target pesticide	Regional change in net returns (*real*)	Change in net returns/ acre (*total*)[2]	Regional change in net returns (*total*)
Methamidophos	Esfenvalerate	19.94	15.27	-53	-123	7,500	-922,500	-367	-2,754,919
Methomyl	None	19.43	0	-67	-123	5,100	-621,300	-499	-287,709
Methomyl	Permethrin	19.43	11.09	0	8	5,100	42,534		
Methomyl	Endosulfan	19.43	8.75	0	11	5,100	54,466		
Carbaryl	Esfenvalerate	11.36	15.27	0	-4	2,500	-9,756		
Oxydemeton-methyl	Esfenvalerate	18.48	15.27	0	3	1,500	4,834		
Dimethoate	Endosulfan	6.46	16.64	0	-10	1,100	-11,194		
Diazinon	None	18.53	0	-50	-123	1,000	-123,000	-329	-329,470
Bensulide	None	27.73	0	-53	-123	5,000	-615,000	-340	-1,701,369
Chlorothalonil	None	48.93	0	-50	-123	6,500	-799,500	-299	-1,943,955
Chlorothalonil	Copper	48.93	32.96	-67	-123	6,500	-799,500	-452	-2,938,195
Mancozeb	Copper	26.39	32.96	-59	-123	5,500	-676,500	-419	-2,302,121

[1]In some cases the estimated change in net returns per acre (net returns with the alternative pesticide minus net returns with the FQPA target pesticide) was greater (in absolute value) than net returns per acre with the FQPA target pesticide. In such cases assuming the change is a negative value, growers would lose more than 100% of expected net returns. The term (*real*) refers to the estimates where the change in net returns per acre(in absolute value) is less than or equal to net returns per acre with the FQPA target pesticide. This would be the greatest expected real loss resulting from the withdrawal of the FQPA target pesticide since growers would not continue to operate where expected net returns are negative.

[2]The term (*total*) gives the estimates where the change in net returns per acre is negative and greater (in absolute value) than net returns per acre with the FQPA target pesticide. It is assumed that growers would discontinue production before suffering losses this great.

Table 15. **Watermelon - Texas Lower Rio Grande Valley**; Selected Results of Study of Potential Economic Impact of FQPA on Texas Vegetables. (Assuming the FQPA target pesticide is withdrawn and the alternative pesticide is applied in its place)

FQPA target pesticide	Alternative pesticide	FQPA target pesticide cost/acre	Alternative pesticide cost/acre	Percent change in yield	Change in net returns/ acre (*real*)[1]	Acres treated with FQPA target pesticide	Regional change in net returns (*real*)	Change in net returns/ acre (*total*)[2]	Regional change in net returns (*total*)
Methomyl	Permethrin	19.94	22.19	-20	-70	5,367	-375,690	-113	-608,835
Methomyl	Bacillus Thuringiensis	19.94	26.75	-38	-70	5,367	-375,690	-249	-1,336,048
Oxamyl	None	16.12	0	-56	-70	5,000	-137,690	-311	-612,485
Diazinon	None	16.71	0	-56	-70	4,050	-283,500	-321	-1,299,200
Diazinon	Imidacloprid	16.71	85.52	-20	-70	4,050	-283,500	-194	-786,738
Dimethoate	Imidacloprid	12.07	64.25	-56	-70	2,750	-192,500	-390	-1,071,620
Carbofuran	None	13.33	0	-56	-70	2,030	-142,100	-324	-658,065
Azinphos-methyl	Bacillus thuringiensis	7.96	13.38	-20	-70	1,700	-119,000	-133	-226,738
Azinphos-methyl	Permethrin	7.96	11.09	-20	-70	1,700	-119,000	-131	-222,859
Azinphos-methyl	cyromazine	7.96	27.97	-56	-70	1,700	-119,000	-358	-607,776
Methamidophos	None	13.11	0	-53	-70	650	-45,500	-306	-198,666
Methamidophos	Imidacloprid	13.11	67.72	-49	-70	650	-45,500	-347	-225,623
Bensulide	None	27.73	0	-56	-70	4,150	-290,500	-310	-1,285,546

Table 15. **Watermelon - Texas Lower Rio Grande Valley**; Selected Results of Study of Potential Economic Impact of FQPA on Texas Vegetables. (Assuming the FQPA target pesticide is withdrawn and the alternative pesticide is applied in its place) (continued)

FQPA target pesticide	Alternative pesticide	FQPA target pesticide cost/acre	Alternative pesticide cost/acre	Percent change in yield	Change in net returns/ acre (*real*)[1]	Acres treated with FQPA target pesticide	Regional change in net returns (*real*)	Change in net returns/ acre (*total*)[2]	Regional change in net returns (*total*)
Mancozeb	None	28.01	0	-56	-70	7,000	-490,000	-309	-2,166,430
Mancozeb	Azoxystroin	28.01	72.96	0	-45	7,000	-314,650		
Chlorothalonil	None	25.40	0	-56	-70	6,000	-420,000	-312	-1,872,600
Chlorothalonil	Azoxystroin	25.40	109.45	0	-70	6,000	-420,000	-84	-504,276
Maneb	None	15.88	0	-56	-70	5,000	-350,000	-322	-1,608,100
Maneb	Azoxystroin	15.88	72.96	0	-57	5,000	-285,400		
Benomyl	None	25.89	0	-56	-70	4,700	-329,000	-312	-1,464,567

[1]In some cases the estimated change in net returns per acre (net returns with the alternative pesticide minus net returns with the FQPA target pesticide) was greater (in absolute value) than net returns per acre with the FQPA target pesticide. In such cases assuming the change is a negative value, growers would lose more than 100% of expected net returns. The term (*real*) refers to the estimates where the change in net returns per acre(in absolute value) is less than or equal to net returns per acre with the FQPA target pesticide. This would be the greatest expected real loss resulting from the withdrawal of the FQPA target pesticide since growers would not continue to operate where expected net returns are negative.

[2]The term (*total*) gives the estimates where the change in net returns per acre is negative and greater (in absolute value) than net returns per acre with the FQPA target pesticide. It is assumed that growers would discontinue production before suffering losses this great.

Table 16. Total Acres Treated per **FQPA** Target Pesticide for All Study Crops by Pesticide Type.

Pesticides	Potatoes	Onions	Cabbage	Watermelon	Total
Insecticides					
Diazinon	1,740	9,673	3,763	31,650	46,826
Carbaryl			417	33,160	33,577
Methomyl	1,305	10,880	4,341	16,017	32,543
Malathion				32,310	32,310
Dimethoate			1,295	21,200	22,495
Phorate	18,150				18,150
Oxydemeton-methyl				13,380	13,380
Oxamyl	1,495	4,801		5,300	11,596
Disulfoton	6,750		4,099		10,849
Carbofuran				5,830	5,830
Ethoprop	4,500		790		5,290
Methamidophos	3,233			1,400	4,633
Chlorpyrifos		2,400	2,224		4,624
Azinphos-methyl				4,200	4,200
Thiodicarb			3,942		3,942
Methyl-parathion		1,602	880		2,482
Acephate			1,250		1,250
Herbicides					
Bensulide			4,000	30,000	34,000
EPTC	7,963				7,963
Metribuzin	14,483				14,483
Fungicides					
Chlorothalonil	22,925	13,225	7,450	55,450	99,050
Mancozeb	22,900	12,340		26,200	61,440
Maneb	13,900	11,613	5,050	10,300	40,863
Propamocarb	15,393				15,393
Iprodione	2,900	11,009			13,909
Benomyl				11,800	11,800
Captan	7,650	800			8,450
Fosetyl-aluminum			2,370		2,370
Thiram		1,800			1,800
Dichloropropene		363			363

Table 17. Total Economic Impact of Pesticide Use Withdrawal per **FQPA** Target Pesticide for All Study Crops by Pesticide Type.

Pesticides	Potatoes	Onions	Cabbage	Watermelon	Total
Insecticides					
Diazinon	(494,800)	(3,497,763)	(1,386,972)	(3,247,380)	(8,626,915)
Phorate	(6,728,105)				(6,728,105)
Malathion				(3,557,890)	(3,557,890)
Carbaryl			(299,787)	(2,873,416)	(3,173,203)
Disulfoton	(1,795,500)		(938,958)		(2,734,458)
Dimethoate			(380,466)	(2,063,367)	(2,443,833)
Methomyl	(227,062)	(1,102,032)	(732,065)	(374,117)	(2,435,276)
Chlorpyrifos		(898,185)	(368,799)		(1,266,984)
Ethoprop	(1,253,250)				(1,253,250)
Oxydemeton-methyl				(1,238,656)	(1,238,656)
Thiodicarb			(921,453)		(921,453)
Oxamyl	227,838	(952,205)		(175,190)	(899,557)
Acephate			(900,555)		(900,555)
Methyl-parathion		(499,350)	(358,850)		(858,200)
Methamidophos	(561,799)		(19,278)	(264,250)	(845,327)
Carbofuran				(547,940)	(547,940)
Azinphos-methyl				(431,500)	(431,500)
Herbicides					
Bensulide			(1,034,720)	(3,001,993)	(4,036,713)
EPTC	(2,962,774)				(2,962,774)
Metribuzin	(382,531)				(382,531)
Fungicides					
Mancozeb	(5,286,534)	(9,982,524)		(2,594,810)	(17,863,868)
Chlorothalonil	(6,599,858)	(6,566,062)	(1,504,018)	(2,137,414)	(16,807,352)
Maneb	(3,858,580)	(6,943,807)	(2,427,648)	(574,315)	(13,804,350)
Propamocarb	(7,064,512)				(7,064,512)
Iprodione	(1,193,060)	(3,371,568)			(4,564,628)
Thiram		(2,017,800)			(2,017,800)
Captan	(504,594)	(763,872)			(1,268,466)
Fosetyl-aluminum			(498,932)		(498,932)
Benomyl				(263,153)	(263,153)
Dichloropropene		(14,221)			(14,221)

Note: Numbers in parentheses indicate negative impact. Numbers not in parentheses indicate positive impact.

Table 18. Total Acres Treated, Estimated Loss if Withdrawn, and Percent Loss of Net Returns of All Study Crops Combined per **FQPA** Target Pesticide.

Pesticides	**Acres Treated**	**Estimated Loss if Withdrawn**	**Loss Percent of Net Returns**
Insecticides		($)	
Diazinon	46,826	(8,630,176)	17
Phorate	18,150	(6,728,105)	13
Malathion	32,310	(3,557,890)	7
Carbaryl	33,577	(3,173,203)	6
Disulfoton	10,849	(2,734,458)	5
Dimethoate	22,495	(2,443,833)	5
Methomyl	32,543	(2,431,430)	5
Chlorpyrifos	4,624	(1,266,984)	3
Ethoprop	5,290	(1,253,250)	3
Oxydemeton-methyl	13,380	(1,238,656)	2
Thiodicarb	3,942	(921,453)	2
Oxamyl	11,596	(905,716)	2
Acephate	1,250	(900,555)	2
Methyl-parathion	2,482	(858,200)	2
Methamidophos	4,633	(845,327)	2
Carbofuran	5,830	(547,940)	1
Azinphos-methyl	4,200	(431,500)	1
Herbicides			
Bensulide	34,000	(4,036,713)	8
EPTC	7,963	(2,962,774)	6
Metribuzin	14,483	(382,531)	1
Fungicides			
Mancozeb	61,440	(17,863,868)	36
Chlorothalonil	99,050	(16,807,352)	34
Maneb	40,863	(13,804,350)	28
Propamocarb	15,393	(7,064,512)	14
Iprodione	13,909	(4,564,628)	9
Thiram	1,800	(2,017,800)	4
Captan	8,450	(1,268,466)	3
Fosetyl-aluminum	2,370	(498,932)	1
Benomyl	11,800	(263,153)	1
Dichloropropene	363	(14,221)	0

Table 19. Pesticide Highest Label Rates, Rates Reported by Questionnaire Respondents, Difference, Difference Percent of Respondent Rate and Number of Applications Reported by Respondents for **Potatoes**.

Pesticides	Unit	Highest Label Rate	Respondent Rate	Difference	Percent Difference	Respondent Number of Applications
Insecticides						
Lannate LV	pint	3	2.13	0.87	41	2.25
Di-Cession 8E	pint	4	1	3	300	1
Di-Cession 15G	pound	26.7	15	11.7	78	1.5
Phorate 20G	pound	17.7	15	2.7	18	1
Thimet 20G	pound	17.7	10.3	7.4	72	1
Monitor 4E	pint	2	1.13	0.87	77	2.13
Vydate L	gallon	4	1	3	300	1
Methyl parathion	pint	3	1	2	200	1
Pounce 3.2 EC	ounce	8	6	2	33	1.5
Provado 1.6 F	ounce	3.75	3.25	0.5	15	4
Admire 2 F	ounce	18.4	13	5.4	42	2
Thiodan 3EC	quart	1.33	1	0.33	33	2
Asana XL	ounce	9.6	8	1.6	20	2
Herbicides						
Sencor 4	pint	2	1	1	100	1
Lexone DF	pound	1.33	.34	0.99	291	1.5
Eptam 7E	pint	7	4.75	2.25	47	1.5
Dual 8E	pint	3	1.5	1.5	100	1
Dual II	pint	2	1.5	0.5	33	1
Prowl 3.3EC	pint	6	1.5	4.5	300	1
Gramoxone extra	pint	1.5	1.2	0.3	25	1

Table 19. Pesticide Highest Label Rates, Rates Reported by Questionnaire Respondents, Difference, Difference Percent of Respondent Rate and Number of Applications Reported by Respondents for **Potatoes**. (continued)

Pesticides	Unit	Highest Label Rate	Respondent Rate	Difference	Percent Difference	Respondent Number of Applications
Fungicides						
Mocap granular 10%	pound	120	30	90	300	1
Bravo 720	pint	1.5	1.1	0.4	36	5.1
Bravo Ultrex	pound	1.4	1.4	0	0	6
Copper	pound	6	4.5	1.5	33	2.5
Dithane M-45	pound	2	2	0	0	4
Dithane F-45	pint	3.2	2	1.2	60	2
Super Tin	ounce	3.75	2	1.75	88	3
Rovral 4FL	pint	2	1.5	0.5	33	3

Table 20. Pesticide Highest Label Rates, Rates Reported by Questionnaire Respondents, Difference, Difference Percent of Respondent Rate and Number of Applications Reported by Respondents for **Onions**.

Pesticides	Unit	Highest Label Rate	Respondent Rate	Difference	Percent Difference	Respondent Number of Applications
Insecticides						
Methyl parathion 4EC	pint	1	1.15	-0.15	-13	1.4
Lannate LV	pint	3	1.5	1.5	100	2.5
Diazinon AG500	pint	8	3.5	4.5	129	1
Lorsban LV	pint	1.1	1.9	-0.8	-42	1
Ammo 2.5EC	ounce	5	4.11	0.89	22	3.5
Karate 1E	ounce	3.84	3.7	0.14	4	3.75
Ambush 2E	ounce	19.2	8.9	10.3	116	5
Herbicides						
Roundup	pint	10	1.5	8.5	567	5.25
Goal 2XL	pint	1	.5	0.5	100	1.5
Buctril 4EC	pint	.75	.63	0.12	19	1
Dacthal W-75	pound	14	11	3	27	1
Gramoxone Extra	pint	3	1.5	1.5	100	1
Trifluralin 4EC	pint	1.25	1	0.25	25	1
Fungicides						
Bravo 720	pint	2	1.7	0.3	18	3.7
Rovral 4FL	pint	1.5	1.28	0.22	17	2.15
Dithane M-45	pound	3	1.5	1.5	100	1.5
Dithane F-45	pint	4.8	3.5	1.3	37	5
Maneb 75DF	pound	3	2	1	50	2.5
Manex FL	pint	4.8	3.1	1.7	55	6.25

Table 20. Pesticide Highest Label Rates, Rates Reported by Questionnaire Respondents, Difference,

Difference Percent of Respondent Rate and Number of Applications Reported by Respondents for **Onions**. (continued)

Pesticides	Unit	Highest Label Rate	Respondent Rate	Difference	Percent Difference	Respondent number of Applications
Mancozeb 200DF	pound	3	2.6	??	ERR	2.5
Aliette WDG	pound	3	2	1	50	2
Ronilan DF	pound	2	1.5	0.5	33	1
Top Cop	pint	4	4	0	0	2
Botran 75-W	pound	5.33	1.1	4.23	385	1

Table 21. Pesticide Highest Label Rates, Rates Reported by Questionnaire Respondents, Difference, Difference Percent of Respondent Rate and Number of Applications Reported by Respondents for **Cabbage**.

Pesticides	Unit	Highest Label Rate	Respondent Rate	Difference	Percent Difference	Respondent Number of Applications
Insecticides						
Lorsban 4E	pint	2.8	1.4	1.4	100	1
Methyl parathion 4EC	pint	3	.75	2.25	300	1.5
Lannate LV	pint	3	1.6	1.4	87	2.2
Diazinon AG500	pint	8	2.5	5.5	220	1.2
Diazinon 14G	pound	28	13	15	115	1
DiSyston 8	pint	1.7	1.8	-0.1	-6	1
Sevin 4F	pint	4	3	1	33	2
Larvin 3.2	pint	2.5	2	0.5	25	2.5
Dimethoate 4EC	pint	1	.9	0.1	11	1.3
Asana XL	ounce	9.6	6	3.6	60	1.5
Thiodan 3EC	quart	1.33	.88	0.45	51	1
Malathion 5EC	pint	2	2	0	0	2
Ambush 2EC	ounce	12.8	9	3.8	42	5.5
Karate 1E	ounce	3.84	3.84	0	0	4.3
Admire 2F	ounce	24	11.2	12.8	114	1
Herbicides						
Treflan 4EC	pint	1.5	1	0.5	50	1
Fungicides						
Bravo 720	pint	1.5	2	-0.5	-25	1.5
Bravo Ultrex	pound	1.4	1	0.4	40	5
Maneb 75DF	pound	2	2	0	0	1.5
Manex FL	quart	1.6	1.65	-0.05	-3	2
Aliette	pound	5	2.25	2.75	122	1.5

Table 22. Pesticide Highest Label Rates, Rates Reported by Questionnaire Respondents, Difference, Difference Percent of Respondent Rate and Number of Applications Reported by Respondents for **Watermelon**.

Pesticides	Unit	Highest Label Rate	Respondent Rate	Difference	Percent Difference	Respondent Number of Applications
Insecticides						
Lannate LV	pint	3	1.4	1.6	114	1.5
Lannate SP	pound	1	.75	0.25	33	2
Malathion 5EC	pint	3	1.6	1.4	87	1
Guthion 2EC, 2L	pint	2	1.6	0.4	25	1.3
Sevin 4F	pint	3	1.5	1.5	100	3
Sevin 80WSP	pint	1.875	1.39	0.485	35	1
Sevin XLR Plus	pint	3	2	1	50	1
Dimethoate 4EC	pint	1	.67	0.33	49	1.5
Metasystox-R SC	pint	2	1.4	0.6	43	1
Thiodan 3EC	pint	2.66	1.7	0.96	56	1.5
Vydate L	pint	4	1.5	2.5	167	1.7
Ambush 2EC	pint	.8	.5	0.3	60	1
Herbicides						
Prefar 4E	quart	6	4.6	1.4	30	1
Treflan 4EC	pint	2	1.1	0.9	82	1
Alanap-L	gallon	2	1	1	100	1
Fungicides						
Bravo 720	pint	3	1.5	1.5	100	3.5
Manzate 200DF	pound	3	2.1	0.9	43	2
Dithane M-45	pound	3	1.5	1.5	100	3
Dithane F-45	quart	2.4	1.25	1.15	92	1.75
Maneb 75DF	pound	2	1.9	0.1	5	1

Table 22. Pesticide Highest Label Rates, Rates Reported by Questionnaire Respondents, Difference, Difference Percent of Respondent Rate and Number of Applications Reported by Respondents for **Watermelon**. (continued)

Pesticides	Unit	Highest Label Rate	Respondent Rate	Difference	Percent Difference	Respondent Number of Applications
Manex	quart	1.6	1	0.6	60	2
Benlate	pound	.5	.58	-0.08	-14	1.7
Bayleton 50% DF	ounce	4	4	0	0	4.5
Sulfur	gallon	3	1	2	200	4
Topsin-M	pound	.5	.46	0.04	9	3.5
Kocide	pound	3	2	1	50	4

Table 23. Emerging New Pesticides Listed by Questionnaire Respondents.

Common Name	Trade Name	Crop	Target Pests	Number of Respondents	Comments
Cymoxanil	Curzate	Potatoes	late blight	4	alternative for propamocarb (Tattoo); need a FQPA target pesticide in mix to prevent selective tolerance; available under section 18.
Dimethomorph	Acrobat	Potatoes	late blight	4	alternative for propamocarb (Tattoo); need a FQPA target pesticide in mix to prevent selective tolerance; available under section 18.
Azoxystrobin	Quadris	Onions	pink rot, Alterneria, downy mildew, purple blotch, tip blight	3	
Chlorfenapyr	Alert	Onions	western flower thrips	1	by American Cyanamid
Fipronil	Regent	Onions	thrips	1	by Rhone-Poulenc; registered for corn but not onions yet.

Note: Pesticides listed here could have uses on crops other than the one given depending on registrations applied for and granted. Some may already have registered label uses for the crop given.

Table 23. Emerging New Pesticides Listed by Questionnaire Respondents. (continued)

Common Name	Trade Name	Crop	Target Pests	Number of Respondents	Comments
Azoxystrobin	Quadris	Cabbage	downy mildew, Alterneria	3	by Zeneca
Indoxicarb	Avaunt/ Steward	Cabbage	diamondback moth, cabbage looper	1	(Dupont?) registration submitted
Tebufenozide	Confirm	Cabbage	lepidopteran pests & beet armyworms	1	Currently registered for walnuts, pecans, and Sec. 3 for Cole crops and peppers until Dec. 1999
Spinosad (Spinosyn A + Spinosyn D)	Tracer, SpinTor, Conserve	Cabbage Watermelon	worm complex, diamond back moth, cabbage looper	2	Tracer currently registered for cotton but not for cabbage. SpinTor registered for Cabbage and Sec. 3 on sweet corn, tuberous and corm vegetables
Chlorfenapyr	Alert	Cabbage	beet army worm, spider mite	1	by American Cyanamid Co.
Emamectin benzoate	Proclaim	Cabbage	diamond back moth, cabbage looper, army worm	1	Novartis
Pymetrozine	Fulfill	Cabbage	aphids	1	Not registered yet
Pyriproxyfen	Knack	Cabbage	whiteflies	1	

Note: Pesticides listed here could have uses on crops other than the one given depending on registrations applied for and granted. Some may already have registered label uses for the crop given.

Table 23. Emerging New Pesticides Listed by Questionnaire Respondents. (continued)

Common Name	Trade Name	Crop	Target Pests	Number of Respondents	Comments
Buprofezin	Applaud	Cabbage	whiteflies	1	
Azoxystrobin	Quadris	Watermelon	downy mildew, Alterneria, gummy stem blight, powdery mildew	6	Could replace Bravo but expensive and may have adverse tolerance problems
Imidacloprid	Admire, Provado	Watermelon	aphids, squash bug	2	Not new but not currently registered for watermelon
chlorpyrifos	Lorsban	Watermelon	beet army worm	1	Not new but not currently registered for watermelon
Metolachlor	Dual	Watermelon	nutsedge	1	Not new but not currently registered for watermelon
Neem Products		Watermelon		1	botanical fungicide/miticide/insecticide; compounds extracted from kernels of neem plant
Trifloxystrobin	Flint	Watermelon	all major foliar diseases	1	(Novartis) Not as broad spectrum as Bravo and Manzate

Note: Pesticides listed here could have uses on crops other than the one given depending on registrations applied for and granted. Some may already have registered label uses for the crop given.

Table 23. Emerging New Pesticides Listed by Questionnaire Respondents. (continued)

Common Name	Trade Name	Crop	Target Pests	Number of Respondents	Comments
Beauveria bassiana	Naturalis-L	Watermelon	whiteflies, mites, aphids	1	Registered in many different countries, pending registration in the U. S.
Beauveria bassiana	BotaniGard	Watermelon	whiteflies, aphids	1	non toxic to man, no waiting periods
Tebuconazole	Folicur	Watermelon	diseases	1	Not registered yet

Note: Pesticides listed here could have uses on crops other than the one given depending on registrations applied for and granted. Some may already have registered label uses for the crop given.

DATA SOURCES

Amosson, S. H. and J. G. Smith. Texas Crop Enterprise Budgets--Texas High Plains--Projected for 1998. Texas Agricultural Extension Service, The Texas A&M University System.

Brandenberbger, L. and J. Sauls. Weed Control in Vegetable, Fruit and Nut Crops. Texas Agricultural Extension Service, The Texas A&M University System. 1997.

Dainello, F. Texas Commercial Vegetable Production Guide. Texas Agricultural Extension Service, The Texas A&M University System. 1996.

DPRA Incorporated. AGCHEMPRICE: *Current USA Prices of Non-fertilizer Agricultural Chemicals.* Manhattan, Kansas: DPRA Incorporated, 1998.

Johnson, J. Texas Crop Enterprise Budgets--South Texas District--Projected for 1998. Texas Agricultural Extension Service, The Texas A&M University System.

The All-Crop, Quick Reference Insect and Disease Control Guide. Willoughby, Ohio: Meister Publishing Company. 1999.

Peña, J. G. Texas Crop Enterprise Budgets--Southwest Texas District--Projected for 1997. Texas Agricultural Extension Service, The Texas A&M University System.

Sanchez, A. M. and M. C. Black. B-1140B, "Texas Plant Diseases Handbook--Chemical Control Supplement for Vegetables and Herbs. Texas Agricultural Extension Service, The Texas A&M University System.

Smith, J. Spanish Onions Projected Costs and Returns per Acre for 1990. Unpublished. Texas Agricultural Extension Service, The Texas A&M University System.

Smith, J. Watermelons Projected Costs and Returns per Acre for 1990. Unpublished. Texas Agricultural Extension Service, The Texas A&M University System.

Sparks, A. N. B-1305, "Texas Guide for Controlling Insects on Commercial Vegetable Crops." Texas Agricultural Extension Service, The Texas A&M University System.

Texas Agricultural Statistics Service. Texas Agricultural Statistics 1996. Texas Department of Agriculture, Bulletin 255, September 1997.

Troxclair, N., M. Black, A. Mize, Rodney. Holloway and J. Taylor. Food Quality Protection Act--Crops at Risk. Worksheet for the Texas Winter Garden and Southwest Texas. Texas Agricultural Extension Service, The Texas A&M University System. 1998.®

APPENDIX A

Potatoes

FQPA target pesticides

Insecticides (organophosphates)

Azinphos-methyl
(Guthion, Sniper)
Diazinon
Dimethoate
Disulfoton (DiSyston)
Ethoprop (Mocap)
Fonofos (Dyfonate)
Malathion
Methamidophos (Monitor)
Methyl-parathion
Phorate (Thimet, Phorate)
Fosmet (Imidan)

Insecticides (carbamates)

Carbaryl (Sevin)
Methomyl (Lannate)
Oxamyl (Vydate)

Herbicides

EPTC (Eptam)
Metribuzin (Sencor,
Lexone)

Fungicides/ bacteriacides/nematicides

Captan
Chlorothalonil
(Bravo, Terranil)
Iprodione (Rovral)
Mancozeb (Dithane,
Ridomil MZ, Penncozeb,
ManKocide)
Maneb (Dithane, Maneb,
Manzate, Polyram)
Metam-sodium (Metam,
Nemasol, Vapam)
Oxamyl (Vydate)
Propamocarb (Tattoo)

non-FQPA target pesticides

Insecticides

Cryolite (Kryocide,
Cryolite)
Endosulfan (Thiodan,
Phaser)
Esfenvalerate (Assana XL)
Imidacloprid (Admire,
Provado)
Methoxychlor
Permethrin (Ambush,
Pounce)

Herbicides

DCPA (Dacthal)
Metolachlor (Dual)
Paraquat
(Gramoxone Extra)
Sethoxydim (Poast)
Pendimethalin (Prowl)
Glyphosate (Roundup)

Fungicides

Myrothecium (Ditera)
Trichoderma (Bio-Ag)
Thiophanate-methyl (Tops)
Thiobendazole (Mertect)
Streptomycin sulfate (Agri-
mycin)
Mefenoxam + copper
(Ridomil Gold Copper)
Triphenyltin hydroxide
(Super Tin)
Copper + Zinc
Copper
Sulfur

APPENDIX A (continued)

Onions

FQPA targeted pesticides

Insecticides (organophosphates)

Azinphos-methyl (Guthion, Sniper)
Chlorpyrifos (Lorsban)
Diazinon
Fonofos (Dyfonate)
Methyl-parathion

Insecticides (carbamates)

Methomyl (Lannate)
Oxamyl (Vydate)

Herbicides

Metolachlor-metribuzin (Turbo)

Fungicides

Captan
Chlorothalonil (Bravo, Terranil)
Dichloropropene (Telone)
Fosetyl-aluminum (Aliette)
Iprodione (Rovral)
Mancozeb, Maneb (Maneb, Dithane, Manzate, Pencozeb)
Thiram

non-**FQPA** targeted pesticides

Insecticides

Cypermethrin (Ammo)
Lambda-cyhalothrin (Karate, Warrior)
Permethrin (Ambush, Pounce)

Herbicides

Paraquat (Gromoxone Extra)
Sethoxydim (Poast)
Glyphosate (Roundup)
Oxyfluorfen (Goal)
Bromoxynil (Buctril)
DCPA (Dacthal)
Trifluralin (Treflan)

Fungicides

Metalaxyl (Ridomil)
Mefenoxam (Ridomil Gold)
Thiophanate-methyl (Topsin M)
Vinclozolin (Ronilan)
Dicloran (Botran)
Copper
Sulfur

APPENDIX A (continued)

Cabbage

FQPA targeted pesticides

Insecticides (organophosphates)

Acephate (Orthene)
Azinphos-methyl (Guthion, Sniper)
Chlorpyrifos (Lorsban)
Diazinon
Dimethoate
Disulfoton (Disyston)
Ethoprop (Mocap)
Fonofos (Dyfonate)
Malathion (Malathion, Fyfanon)
Methamidophos (Monitor)
Methyl parathion
Naled (Dibrom)
Oxydemeton-methyl

Insecticides (carbamates)

Carbaryl (Sevin)
Methomyl (Lannate)
Thiodicarb (Larvin)

Herbicides

Bensulide (Prefar)

Fungicides/ bacteriacides/nematicides

Captan
Chlorothalonil (Bravo, Terranil)
Mancozeb
Maneb
Fosetyl-aluminum (Aliette)
Thiram

non-FQPA targeted pesticides

Insecticides

Cryolite (Kryocide, Cryolite)
Cypermethrin (Ammo)
Endosulfan (Thiodan, (Endosulfan, Phaser)
Esfenvalerate (Asana XL)
Imidacloprid (Admire, Provado)
Lambda-cyhalothrin (Karate, Warrior)
Lindane (Gamma Mean, Lindane)
Methoxychlor
Permethrin (Ambush, Pounce)
Tralomethrin (Scout X-tra)

Herbicides

DCPA (Dacthal)
Napropamide (Devrinol)
Oxyfluorfan (Goal)
Paraquat (Gramoxone Extra)
Sethoxydim (Poast)
Glyphosate (Roundup)
Trifluralin (Treflan)

Fungicides

Fenamiphos (Nemacur)
Metalaxyl (Ridomil)
Mefenoxam (Ridomil Gold)
Myrothecium (DiTera)
Quintozene (PCNB, Terraclor)
Trichoderma (Bio-Ag)
Oxadixyl (Anchor)
Mefenoxam + copper (Ridomil Gold Copper)
Metalaxyl + copper (Ridomil/Copper)
Copper (Kocide)
Sulfur

APPENDIX A (continued)

Watermelon

FQPA targeted pesticides

Insecticides
<u>(organophosphates)</u>

Azinphos-methyl
  (Guthion, Sniper)
Diazinon
Dimethoate
Malathion
Methamidophos (Monitor)
Naled (Dibrom)
Oxydemeton-methyl
  (Metasystox-R)

<u>Insecticides (carbamates)</u>

Carbaryl (Sevin)
Carbofuran (Furadan)
Methomyl (Lannate)
Oxamyl (Vydate)

<u>Herbicides</u>

Bensulide (Prefar)

<u>Fungicides</u>

Captan
Chlorothalonil
  (Bravo, Terranil)
Mancozeb (Ridomil MZ,
  Ridomil Gold MZ,
  Penncozeb, Dithane,
  Manzate, ManKocide)
Maneb (Dithane, Pencozeb)
Thiram
Benomyl (Benlate)

non-FQPA targeted pesticides

<u>Insecticides</u>

Abamectrin (Agrimek)
Cryolite (Kryocide)
Cyromazine (Trigard)
Dicofol (Kelthane/Dicofol)
Endosulfan
  (Thiodan, Phaser)
Esfenvalerate (Asana XL)
Lindane
Methoxychlor
Permethrin (Ambush, Pounce)

<u>Herbicides</u>

Naptalam (Alanap-L)
DCPA (Dacthal)
Paraquat
  (Gramoxone Extra)
Sethoxydim (Poast)
Glyphosate (Roundup)
Trifluralin (Treflan)

<u>Fungicides</u>

Triadimefon (Bayleton)
Mefenoxam (Ridomil Gold)
Thiophanate methyl
  (Topsin-M)
Copper + Zinc (Copper-Z)
Copper (Kocide)
Sulfur

APPENDIX B

Responses to the request to write any comments or other information that might be helpful in assessing the impact of losing the use of FQPA target pesticides.

Potatoes

Main problems: Need fungicides to control seed piece rot and especially early and late blight. Az strain of late blight can be 100% destructive. Also need a good vine dissident. Currently only have 1 that is effective (paraquat) it is marginal. We lose that and we are in trouble. (High Plains)

Without economical alternatives with the same efficiency or better, potatoes will cease to be grown in this area. (Lower Rio Grande Valley)

If FQPA fungicides were unavailable, we stand to have a 100% loss to late blight in years such as last year. This would happen within 3 years.

This is our third year of commercial fresh market potato production. We do not have enough data to give accurate figures. (Lower Rio Grande Valley)

Losing Phorate®, Eptam® and Tattoo® would cause a severe impact. Losing Monitor®, Lexone®, Bravo® and Dithane® would cause a moderate impact in the Winter Garden area. (Winter Garden)

Losing the use of FQPA targeted pesticides would actually increase overall pesticide use in our area. (Winter Garden)

Loss of any single pesticide can be overcome. Loss of several in a category ie, Bravo® and mancozeb would create extreme hardship. (Winter Garden)

Onions

The insecticides and fungicides are very important because of the quality that could be suffered if not available.

If pesticides are taken away or are not available we would not even consider growing onions because of labor cost. There are too many diseases to control without aid of pest control chemicals. (High Plains)

Without the use of the FQPA targeted pesticides, especially the fungicides, the risk would be too great to grow onions in this area making Mexico more attractive for our farming operation. (Lower Rio Grande Valley)

At present the largest impact would come from the loss of fungicides that are extensively in use. Any loss without alternatives (none as all are under fire) could be devastating.

Because of our high humidity and mild winter, plant diseases are the most critical concern. If we lose any of our fungicides, we will probably lose the onion industry here. (Lower Rio Grande Valley)

The loss of chlorothalonil and mancozeb and Rovral® could cause 100% losses to occur most years. (Lower Rio Grande Valley)

We need alternative fungicides above all. With potential loss of organo-chlorine class it would be devastating to Texas onions. (Winter Garden)

The loss of these targeted pesticides could not only increase the potential of resistance to the alternatives, but would make an already risky crop, too risky to produce in the Winter Garden. (Winter Garden)

As long as there is suitable and economical replacement, impact will be minimal. Loss of rotational products will impact in the long term. Loss of weed and insect control on rotational crops also affect onions. (Winter Garden)

There won’t be any seed treatments or fungicides. In a wet year like 1997 the loss could be 100%. (Winter Garden)

Cabbage

They provide excellent control for major pests and have good reason on the number of days to harvest. (High Plains)

Again - alternatives to targeted pesticides are most often from the FQPA list itself indicate the lack of replacements if "niche" products are lost. (Lower Rio Grande Valley)

Diazinon as soil insecticide for soil insects is a must. Broad spectrim fungicide such as mancozeb and chlorothalonil could cause a 100% loss. (Lower Rio Grande Valley)

The loss of these targeted pesticides would force us to use the listed alternative pesticides more frequently, thereby increasing the potential for resistance. (Winter Garden)

We will lose all our seed treatments and fungicides. One infected lot of seed and one wet year and we'll be out. Our ability to kill flea beetles will be greatly reduced. Economics will be adversely affected. Replacement materials will be much more. (Winter Garden)

Watermelon

Watermelon are sensitive to diseases which intensify with plant stress. Insects increase plant stress, thus, increase disease. (High Plains)

Watermelons cannot be grown economically without Bravo® and Lannate®. Other pesticides are also needed to alternate with these. (High Plains)

Watermelon plants are extremely sensitive to the diseases that are present every year. Insects not only cause the plants to stress, they carry diseases from one plant to another. Both are essential to control. (High Plains)

See delivery problem due to aphid not being controlled. See tonage being reduced a potential of 50-60%. (High Plains)

Loss of soil insecticides could cause 80% loss. Loss of chlorothalonil and mancozeb type broad spectrum fungicides could cause 100% loss and develop resistance to fungicides like Ridomil®, & Quadris® coming. (Lower Rio Grande Valley)

In the valley we are more affected by weeds, disease and insects that affect the quality of the fruit. The loss of quality affects the quantity of our sales. The watermelons we grow are on drip irrigation with plastic mulch. We grow 2/5 of our acreage in hybrid seedlers and one thin hybird seeded. We spray pesticides as needed and in keeping with integrated pest management systems. We try to stay away from chemicals that are extremely toxic to bees (we use bees for pollination). We also are careful with highly toxic chemicals and systemics especially in watermelons. When using plastic mulch we have less need for herbicides. Without using plastic mulch, the loss of Prefar® would be a catastrophe. (Lower Rio Grande Valley)

At least 75% dryland watermelons will not be grown. (Lower Rio Grande Valley)

Loss of Bravo would be most critical. (Winter Garden)

Melons have become less profitable in past years due to virus and fungus diseases. Continued decline of labeled pesticides will only result in lower profits and less acres. (Winter Garden)

Labeled chemicals are already limited for minor crops. Cancellations of registration for more chemicals would be devastating. (Central Texas)

Chlorothalonil would be most damaging if lost. (Central Texas)

It will cost more per acre to spray for pests and it will cause careful scouting of fields since multiple sprays will become necessary with a loss products. (East Texas)

I as a producer who plans to be in business for a long time have already began trying to use less herbicides, insecticides, and fungicides. I have a lot of land available and rotating with pasture and winter cover crops have helped in weed control and fungus problems. I try to take the very best care of my helpful insects and never use an insecticide unless it is getting completely out of hand. I also tell neighbors to use insecticides wisely. (East Texas)