AN EVALUATION OF THE EFFECTS OF CERTAIN PESTICIDES ON THE YIELD AND QUALITY OF TOMATO (Lycopersicon esculentum Mill. CV.Roma) FRUITS AND SEEDS

Nana Sakyiwa Olympio
BSc, MSc, PhD
Department of Horticulture
University of Science & Technology, Kumasi, Ghana

ABSTRACT

Studies on the influence of four fungicides and two insecticides on the yield and quality of fruits and seeds from treated tomato (Lycopersicon esculentum Mill.CV. Roma) mother plants were conducted at the Department of Horticulture, University of Science and Technology, Kumasi. The fungicides, Dithane M45, Orthodifolatan 80WP, Benlate, and Macuprax and the insecticides, Vetox and Azodrin were sprayed on tomato plants ten days after transplanting and repeated at ten days intervals for six weeks at recommended rates.

The results indicated that some fungicides and insecticides had significant effects on the total number and weight of fruits produced, the marketable fruit number and weight, and the acidity of the fruits. All treatments, however, had no effect on the pH of the juice, the shelf life, nor the seed yield, size or quality as shown by the 1,000 seed weight and the seedling evaluation tests.

Keywords: fungicides, insecticides, tomato, fruit, seed, yield

INTRODUCTION

In developing countries, and Ghana in particular, the seed industry is not very well developed. Vegetable seed production in the country is plagued with a lot of problems including lack of vernalization of most of the cool season crops, high humidity and temperature, and lack of personnel trained in vegetable seed production.[1] An estimated 5 per cent crop loss is attributed to poor quality seed in the U.S.A.[2], so it is expected that the percentage will be higher in a developing country like Ghana, where emphasis has not yet been put on seed quality.

To improve production of crops the use of fungicides and insecticides is essential. Their use normally increases yield by way of reduction in diseases and pest damage. However, not much work has been done to find their effect on the quality of seeds produced, although it is known that premature application of pesticides on parent plants can cause loss in germinability [3]

This paper gives a report on experiments performed to study the effects of the fungicides Dithane M45, Benlate, Macuprax or Orthodifolatan 80WP and insecticides Vetox or Azodrin on the yield and quality of fruits and seeds of treated tomato plants. These chemicals are normally used on tomato to reduce fruit damage.

MATERIALS AND METHODS

The experiment was conducted at the Department of Horticulture, University of Science and Technology experimental plots. Seeds of tomato (Lycopersicon esculentum Mill. cultivar Roma) were sown in sterilized seed mix and pricked out after six days into boxes filled with pricking out mix. Seedlings were transplanted three weeks later to the field after ploughing, harrowing, levelling, and pegging in rows spaced at 90cm apart and 60cm between plants. There were fifteen treatments replicated three times in a randomized complete block design. Each plot had twelve plants surrounded by guard rows.

Treatments were four fungicides and one untreated control and two insecticides (with one untreated control) applied at their mean recommended rates and periods which worked out to be Dithane M45 at 1.75 kg/ha, Difolatan at 1.8kg/ ha, Benlate at 1.5kg/ ha, Macuprax 1.5 kg /ha, Vetox at 1.5 kg/ ha and Azodrin at 0.75kg/ ha. Spraying was started two weeks after transplanting and thereafter at ten days intervals for six weeks, applying insecticides and fungicide as a mixture on plots where both are assigned (See Tables).

Visual scores on diseases and pests were recorded. The effects of the fungicides and insecticides on the yield of fruits were evaluated from the total and marketable weight and number. The marketable fruits were taken as those undamaged and and above 20g weight. The parameters examined for fruit quality were pH and per cent acidity of the fruit juice. Mean weight per seed,, mean seed yield per fruit, per cent germination whilst seedling dry weight was used as a measure of seed quality. In the seedling dry weight determinations 50 seedlings were weighed and dried in an oven until there was no change in weight; usually for 24 hours. The dry weight per seedling was taken as a measure of vigour of the seed as shown by Tonkin [4].

RESULTS AND DISCUSSION

EFFECTS OF FUNGICIDES

The results indicate a significant effect ($P = 0.01$) of some fungicides on the fruit yield of the crop both in number and weight (Tables 1 and 2). Benlate significantly increased fruit number and weight but Difolatan had no noticeable effect on the yield as the number and weight recorded was about the same as those from the control plots. It is known that use of fungicide reduces losses due to diseases on tomato plants [5] and this probably accounts for the increased fruit yield, especially marketable yield. Quinn [6] submitted that Difolatan gave control of anthracnose and it effectively increased yield of tomato crop. An Ultra-low-volume (ULV) method was recommended to improve uptake and therefore effectiveness.[7]

The use of most of the fungicides significantly ($P = 0.05$) increased marketable yield (Tables 3 and 4), with the exception of Difolatan which had the least number and weight of marketable fruits, even less than those from the untreated plots. There is the probablity that it was unable to control some of the diseasses which were identified as fruit rot, early and late blight, and thus reduce the yield of the marketable fruits.

It was observed that none of the fungicide had any significant effect on the pH of the fruits (Table 5). Gould [8], presented desirable pH and per cent acidity values in processing tomato to be 4.0 to 4.2 for pH and 5.0 to 5.7% for acidity. Though the cultivar used in the experiment was a canning one, it is also popular in the fresh markets of Ghana. The fungicides tried, did not change the pH of the fruit which

TABLE 1: Influence of Fungicides and Insecticides on the mean number of fruits per plant from treated tomato mother plants.

Fungicides	Insecticides			Fungicide	LSD
	Vetox	Azodrin	Control (no insecticides)	Means	5%
Dithane M45	33.9	36.4	17.6	29.0	6.1
Orthodifolatan	23.9	24.1	15.9	21.3	
Benlate	27.0	38.3	23.3	29.5	
Macuprax	30.7	28.3	18.1	25.7	
Control (no fungicide)	31.2	26.2	11.6	23.1	
Insecticides Means	29.2	30.4	17.3		
LSD 5%	10.3				

TABLE 2: Influence of Fungicides and Insecticides on the mean fruit yield per plant from treated tomato mother plants (g)

Fungicides	Insecticides			Fungicide	LSD
	Vetox	Azodrin	Control (no insecticides)	Means	5%
Dithane M45	728	758	358	615	84
Orthodifolatan	468	487	309	422	
Benlate	654	902	539	698	
Macuprax	593	591	393	525	
Control (no fungicide)	593	485	212	430	
Insecticide Mean	607	645	362		
LSD 5%	170				

TABLE 3: The effect of fungicides and insecticides on the mean weight of fruits from treated tomato mother plants (g)

Fungicides	Insecticides			Fungicide	LSD
	Vetox	Azodrin	Control (no insecticide)	Means	5%
Dithane M45	21.4	21.5	20.3	21.1	1.78
Orthodifolatan	19.5	20.2	19.4	19.7	
Benlate	24.2	23.5	23.1	23.6	
Macuprax	19.3	20.9	21.8	20.7	
Control (no fungicide)	18.9	18.5	18.3	18.5	
Insecticide Means	20.7	20.9	20.6		
LSD 5%	NS*				

NS* - No significant difference between treatment means.

TABLE 4 : The effect of fungicides and insecticides on the mean number of marketable fruits per plot (9.3m²) from treated tomato mother plants

Fungicides	Insecticides			Fungicide	LSD	
	Vetox	Azodrin	Control (no insecticide)	Means	5%	1%
Dithane M45	7.8	7.8	2.3	5.9	1.7	2.5
Orthodifolatan	3.2	3.3	1.8	2.8		
Benlate	6.6	10.1	1.8	6.9		
Macuprax	6.2	6.1	2.5	4.9		
Control (no fungicide)	6.0	4.9	1.3	4.1		
Insecticide Means	5.9	6.5	2.5			
LSD 5%	2.9					
1%	4.3					

TABLE 5: The effect of fungicides and insecticides on the mean weight of marketable fruits per plot(9.3m) from treated tomato mother plants (kg)

Fungicides	Insecticides			Fungicide	LSD	
	Vetox	Azodrin	Control (no insecticide)	Means	5%	1%
Dithane M45	7.81	7.84	2.27	5.97	1.73	2.51
Orthodifolatan	3.19	3.35	1.77	2.77		
Benlate	6.66	10.13	1.87	6.89		
Macuprax	6.17	6.11	2.53	4.93		
Control (no fungicide)	6.02	4.92	1.27	4.07		
Insecticide Means	5.97	6.47	1.94			
LSD 5%	2.97					
1%	4.31					

TABLE 6: The effect of fungicides and insecticides on the pH of the fruit juice of treated tomato mother plant

Fungicides	Insecticides			Fungicide	LSD
	Vetox	Azodrin	Control (no insecticide)	Means	5%
Dithane M45	3.9	4.2	4.0	4.0	NS*
Orthodifolatan	4.0	4.1	4.1	4.1	
Benlate	3.9	4.1	4.0	4.0	
Macuprax	4.0	4.0	4.0	4.0	
Control (no fungicide)	4.1	4.1	4.0	4.1	
Insecticide Means	4.0	4.1	4.0		
LSD 5%	NS*				

NS* - No significant difference between treatment means.

TABLE 7: The effect of fungicides and insecticides on the acidity of fruit juice from treated tomato mother plant

Fungicides	Insecticides			Fungicide	LSD	
	Vetox	Azodrin	Control (no insecticide)	Means	5%	1%
Dithane M45	0.59	0.46	0.58	0.54	0.05	0.08
Orthodifoltan	0.60	0.58	0.60	0.59		
Benlate	0.57	0.53	0.47	0.53		
Macuprax	0.52	0.62	0.50	0.54		
Control (no fungicide)	0.44	0.44	0.48	0.45		
Insecticide Means	0.54	0.53	0.53			
LSD 5%	NS					

TABLE 8 : The mean shelf life of fruits from tomato mother plants treated with fungicides and insecticides (Number of days before first sign of deterioration)

Fungicides	Insecticides			Fungicide	LSD
	Vetox	Azodrin	Control (no insecticide)	Means	5%
Dithane M45	37	37	25	33	NS
Orthodifolatan	38	25	28	33	
Benlate	29	31	35	32	
Macuprax	29	29	25	28	
Control (no fungicide)	31	25	31	29	
Insecticide Means	33	29	30		
LSD 5%	NS				

was within the approved values. However, use of fungicide increased the per cent acidity to a satisfactory (for processing) level. Statistically too the fungicides had no effect on the shelf life (Table 8), though the use of Benlate and Dithane M45 caused some increase in the days the fruits took to deteriorate when stored at normal room temperature. Mean day temperature was about 28°C

SEED YIELD AND QUALITY

There was no significant effect of fungicides on the yield of seeds nor the quality of seeds as measured by the seedling evaluation test (Tables 9, 10 and 11). But it was observed that seedlings from Difolatan treated mother plants were slightly smaller than those from the other fungicide treated plants (Table 11). Various pesticides are employed on parent plants while seeds are maturing. Such treatment can influence the subsequent germination and vigour of the seeds [9]. The results of this experiment shows that the use of the fungicides Dithane, Difolatan, Benlate and Macuprax had no influence on the seed quality and can be used on the mother crop.

EFFECTS OF INSECTICIDE

The use of insecticides Vetox or Azadrin on the tomato plant significantly increased ($P = 0.05$) the yield in mean number of fruits per plant and total yield per plant (Tables 1 and 2). The yield almost doubled over the control plots where no insecticides were used. However, the mean fruit weight remained the same under the conditions of the experiment (Table 3). Further, the marketable yield was also highly significantly increased, when plants were treated with insecticides ($P = 0.01$) as shown in Tables 4 and 5. The mean marketable yield figures were similar for the two insecticides.

The results also showed that the insecticides had no effect on the quality of fruit in terms of percentage acidity and the pH of the juice (Tables 6 and 7).

It was also observed that the insecticides had no effect on the shelf life of the fruits harvested from the treated plants (Table 8). This indicated that both Vetox and Azodrin can be used on a tomato crop without much effect on the fruit quality.

SEED YIELD AND QUALITY

The use of the two insecticides had no significant effect on the size, yield and quality of the seeds produced. The seeds produced were of similar size as indicated by the 1,000 seed weight (Table 8) and was not different in the mean weight (Table 9). There was a slight reduction in the seedling dry weight where no insecticides were used but the difference between the treatment means were statistically not significant. Some workers have reported of significant influence of certain pesticides on yield and quality of seed crops. For example, Carlson [3], treated beetroot seed crop with a series of insecticide mixtures and found low seed viability following application of DDT and disulfoton mixture. Other workers have also reported reduced germination of seeds subjected to organiochlorine insecticides, as well as fumigation during storage with chlorinated hydrocarbons [10,11]. Effect of pesticides on germination are known to arise from several complex factors. Details on dosages, frequencies of applications and other variables need to be studied so as to understand some of these effects. Vetox (a carbaryl) is reported to be a safe all-purpose insecticide, while Azodrin (a monocroptophos) is known to be a relatively toxic systemic one [12]. However, their effects on plants is not very much documented. The present results indicate that both can be used on tomato mother plants without any damage on the yield and quality of the seeds produced.

TABLE 9: Mean 1,000 grain weight of seeds from tomato mother plants treated with fungicides and insecticides (g)

Fungicides	Insecticides			Fungicide	LSD
	Vetox	Azodrin	Control (no insecticide)	Means	5%
Dithane M45	0.26	0.24	0.21	0.24	NS
Orthodifolatan	0.31	0.24	0.25	0.27	
Benlate	0.23	0.24	0.22	0.23	
Macuprax	0.23	0.24	0.23	0.23	
Control (no fungicide)	0.20	0.27	0.25	0.24	
Insecticide Means	0.25	0.25	0.23		
LSD 5%	NS				

TABLE 10: The mean seed weight from tomato mother plants treated with fungicides and insecticide (g)

Fungicides	Insecticides			Fungicide	LSD
	Vetox	Azodrin	Control (no insecticide)	Means	5%
Dithane M45	0.18	0.20	0.19	0.19	NS
Orthodifolatan	0.17	0.19	0.17	0.18	
Benlate	0.21	0.22	0.21	0.21	
Macuprax	0.21	0.19	0.19		
Control (no fungicide)	0.18	0.19	0.18	0.19	
Insecticide Means	0.19	0.20	0.19		
LSD 5%	NS				

TABLE 11: Mean dry weight per seedling from tomato mother plant treated with fungicides and insecticides (mg)

Fungicides	Insecticides			Fungicide	LSD
	Vetox	Azodrin	Control (no insecticide)	Means	5%
Dithane M45	78.4	63.9	69.8	77.4	NS
Orthodifolatan	49.5	56.1	55.2	53.6	
Benlate	79.1	84.1	70.4	77.9	
Macuprax	69.2	73.4	68.2	70.3	
Control (no fungicide)	58.7	61.0	50.0		
Insecticide Means	66.9	71.7	62.7		
LSD 5%	NS				

CONCLUSION

During the conditions of the experiment, the fungicides and insecticides used improved fruit yield and quality, especially the marketable weight (P = 0.01) of the treated cultivar. However, none of them significantly influenced the quantity and quality of the seeds produced. Therefore, the chemicals can be safely utilized on tomato crops meant for fruits as well as for seeds.

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