USE OF NON TOXIC MATERIALS FOR WHITEFLY CONTROL AND GROWTH ENHANCEMENT IN CRISPHEAD LETTUCE

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Abstract

Field studies were conducted in Yuma and Tucson in 1993 to determine the effect of several non toxic substances purported to enhance growth and yield of lettuce, and to determine whether these treatments have an effect on whitefly populations. Five applications of the treatments were made beginning four weeks after planting and continuing at weekly intervals. Results indicated that there may be some positive effects of foliar applied methanol and nutrient (nitrogen/iron) treatments, as well as, from the use of Capture insecticide.

Introduction

Each year, a number of new treatments are reported in the popular press for improving plant growth and/or reducing pest populations. Often these reports remain unsubstantiated leaving it up to individual growers, or grower organizations, to determine product efficacy or the accuracy of the claims made. Crop improvement substances that have received recent attention include Agrimethanol, Agronomix, whitewash and silver mulch. Agrimethanol, a low percentage (20%) methanol solution supplemented with a nitrogen source and chelated iron, and Agronomix, a vitamin supplement, were reported to improve plant growth. Whitewash and silver-colored mulch were reported to interfere with the ability of whiteflies to colonize on lettuce and other vegetables. If these claims are substantiated, then it should be possible to increase the profitability of lettuce production, reduce pesticide inputs, and increase harvest quality in a manner compatible with integrated pest management systems. The insect diversity on treated versus untreated plants, and the incidence of infection with common viruses may also be affected. Reducing insect and virus disease pressures should result in improved yields and quality of lettuce.

These studies will serve to evaluate the effects of these non toxic additives on the the growth of lettuce and the control of whitefly with specific reference to effects on biological (fecunditiy) factors associated with the "B" biotype of whitefly. As public concern about pesticides in produce increases, alternative pest control measures need to be established. More important, although the "B" strain of whitefly transmits certain viruses with lower efficiency than the "A" biotype did in the past, this situation may change in the future. This virus or others are likely to follow the "B" strain because of its broad host range and the rapidity with which viruses can mutate.

Materials and Methods

Field trials were established in Yuma during the third week of August, 1993. Trials in Tucson were delayed due to rain. Each four beds of lettuce (c. v. "Empire") were separated by two rows of squash as a border crop to insure adequate whitefly populations for the emerging lettuce. A randomized complete block design with five replications was used. Capture and Admire were applied according to label instructions. Admire was not used in the trials in Tucson. Agronomix, nutrients, insecticides and methanol treatments were applied based on a 20 gallon per acre spray volume. Treatments were applied with a four nozzle sprayer equipped with Teejet 80015 nozzles to plots measuring 50 feet on a 40" bed. Silver mulch was applied as a 50 ft X 12" strip anchored between the heads. Whitewash was applied at 1 lb/gal/200 ft of row. Treatments commenced when plants were four weeks old and continued at weekly intervals for five weeks. Whitefly data collection was initiated when plants were four weeks old. The whitewash was supplied by Wilbur-Ellis Co., 1570 East 20th St., Yuma, Az, and the Agronomix was provided by Roche Vitamins and Fine Chemicals, Hoffmann-La Roche Inc., Nutley, N. J.

Results

Growth Effects of Additives At harvest, the weight of marketable heads, the number of marketable heads, and the average head weight per 20 foot of bed (2 rows) were determined for each plot (Tables 1 and 2). August rains prevented the timely initiation of studies in Tucson, and this may have contributed to lower head weights at the end of the season (Table 2) since the variety was not as well adapted to the latter season. In Tucson, the heads were rated as either soft, firm or hard, or unacceptable, and then weighed.

Tables 1 and 2 show the effects of the treatments on yield parameters. In Yuma and Tucson, the check plots had the lowest yields. In Yuma, aerial applications of insecticides to control crickets were made to insure that an acceptable stand was obtained. These treatments were neither made nor needed in Tucson. Little benefit was found from addition of Agronomix, or use of silver mulch or white wash. Methanol, methanol plus nutrients and nutrients alone provided some measure of yield improvement as did the use of Admire, Capture and Capture plus methanol. It is not known whether combinations of Capture, nutrients and methanol would afford greater yield increases over these components used alone, but it would be interesting to determine if such a synergy were possible. The results obtained with the methanol, and methanol plus nutrients may indicate that just disturbing the whitefly may have some beneficial effect. There was little or no whitefly pressure at the Tucson location yet the trends in both locations from the combination of Capture plus methanol were similar. Methanol may have some insecticidal property of its own. At Tucson, there may have been insects other than whitefly controlled by Capture which were having a detrimental effect on lettuce. Head size was not significantly different for any of the treatments.

Effects on Whitefly The main purpose of the whitefly component of the lettuce field trials was to determine if any of the treatments reduced the whitefly populations on the lettuce, and thus reduced the incidence of viruses in the field. Whitefly counts were initiated in Yuma five weeks after planting, and continued until the lettuce was harvested, nine weeks after planting. No counts were done on the Tucson plots, since there was no substantial whitefly population there. Table 3 shows the results obtained from the field in Yuma. Overall, the untreated control had significantly higher whitefly counts, and the chemical treatments (Capture, Capture with methanol, Admire) had significantly lower whitefly counts than the other treatments. There were no striking differences between the treatments, although we observed that the whitefly counts increased on treatments where the lettuce was growing well, compared to those treatments where the lettuce was stunted.

The lettuce plots were surveyed for virus symptoms on a weekly basis as well. No viruses were detected throughout the trial on the lettuce, although some plants demonstrated a low phytotoxicity five weeks after planting. We observed that the plants displaying the yellow phytotoxicity had more 3-4 instar stage whiteflies than the untreated, healthy controls or the Admire treated lettuce (Table 4). This trend was not detected with either whitefly eggs or early 1-2 instar counts, and suggests that the phytotoxicity is related to the feeding of the 3-4 instars.

Discussion

Methanol at the rates used in this study (20%) would be toxic to most organisms. However, under the high evaporative conditions found in the southwest, methanol rapidly dissipates. When applied with insecticides, methanol may

synergize or increase the efficacy of the insecticide by facilitating increased uptake or distribution of the product on the leaves. Such an effect might reduce the pesticide residue load on the crop and perhaps reduce the number of treatments with traditional insecticides. However, the efficacy of these treatments was not conclusively substantiated in these tests. It is interesting to note that at Yuma, where whiteflies were a problem, the lettuce treated with whitewash, silver mulch, or chemicals had more growth than untreated controls. Was this because of less whitefly activity on the plant? However, lettuce treated with whitewash grew slower than the others, except controls, probably because photosynthesis was restricted.

Table 1. Fresh weight and number of marketable heads, and head weight per 20' of bed for Empire lettuce. Treatments followed by the same letter are not significantly different at the 5 percent level using Fisher's (protected) LSD for comparison of multiple means.

Treatments		Weight of Marketable Heads(lbs.)[1]	Number of Marketable Heads[2]	Head Weight (lbs.)[3]
1.	Check	13.8a	9.6a	1.46
2.	Whitewash[4]	19.1bc	12.8bc	1.49
3.	Nutrients[5]	22.8ef	14.0bc	1.62
4.	Methanol[6]	22.8ef	14.0bc	1.62
5.	Nutrients & Methanol	24.3f	14.8c	1.60
6.	Agronomix[7]	19.4bc	13.0bc	1.48
7.	Agronomix & Methanol	17.9b	12.4b	1.55
8.	Capture	20.2cd	12.2b	1.64
9.	Capture & Methanol	22.3e	13.8bc	1.62
10.	Silver Mulch[8]	22.9ef	14.2bc	1.60
11.	Admire	21.7de	13.4bc	1.63
12.	Control	14.4a	9.8a	1.48

[1]Significant @ P = 0.05
[2]Significant @ P = 0.05
[3]Not Significant
[4]Whitewash applied at 1 lb/gal/200 ft of bed
[5]Nutrients: 1% Urea and 0.1% Chelated Iron
[6]All methanol solutions were 20%
[7]Agronomix applied at 1 lb/A
[8]Silver mulch applied as a 50 ft X 12" strip anchored between the heads

Table 2. Fresh weight and number of marketable heads, and head weight per 20' of bed for Empire lettuce in response to various treatments (Tucson). Treatments followed by the same letter are not significantly different at the 5 percent level using Fisher's (protected) LSD for comparison of multiple means. See Table 1 for list of treatments.

Treatments		Weight of Marketable Heads (lbs.)[1]	Marketable Heads[2]	Head Weight (lbs.)[3]
1.	Check	6.8ab	6.0	1.2
2.	Whitewash	7.5ab	6.4	1.1
3.	Nutrients	5.7a	4.8	0.9
4.	Methanol	9.2b	8.0	1.1
5.	Nutrients & Methanol	9.5b	8.0	1.2
6.	Agronomix	8.8b	7.6	1.1
7.	Agronomix & Methanol	8.1ab	6.6	1.2
8.	Capture	12.7c	9.6	1.3
9.	Capture & Methanol	16.0d	11.0	1.4
10.	Silver Mulch	7.7ab	6.4	1.0

[1]Significant @ P = 0.05
[2] Not Significant
[3] Not Significant

Table 3. Effect of methanol and additives on the presence of whitefly eggs and adults on Empire lettuce (Yuma). Treatments followed by the same letter are not significantly different at the 5 percent level using Fisher's (protected) LSD for comparison of multiple means.

	Treatments	Week 4 (EGGS), (Adults)	Week 5 (Adults)	Week 6 (Adults)	Week 9 (Adults)
1.	Check	5.9a, 69.2a	1.5bcde	0.6a	2.7a
2.	Whitewash	2.4b, 40.8b	1.6abcde	1.9b	0.9b
3.	Nutrients	1.2b, 40.2b	1.5bcde	1.2ab	1.5ab
4.	Methanol	0.4b, 40.8b	2.0bcde	1.4ab	0.4b
5.	Nutrients & Methanol	1.0b, 50.8ab	1.9abcd	1.0ab	0.9b
6.	Agronomix	2.3b, 44.4b	3.0a	1.5ab	1.0b
7.	Agronomix & Methanol	2.1b, 42.0b	2.2abc	1.4ab	1.3b
8.	Capture	0.9b, 18.4c	0.3e	1.4ab	0.7b
9.	Capture & Methanol	1.8b, 17.6c	0.6de	1.4ab	0.3b
10.	Silver Mulch	2.4b, 39.0b	3.0ab	1.6ab	0.9b
11.	Admire	0.7b, 18.8c	1.0cde	1.1ab	0.4b
12.	Check	0.8b, --	1.8abcd	1.4ab	1.2b

Table 4. Stages of whiteflies found on lettuce (Yuma) and the possible relationship to leaf yellows virus.

Treatment	Eggs	Total Nymphs	1-2 Instars	3-4 Instars
Admire[1]	5.2	22.8	21.0	1.8
Controls (Healthy)[1]	31.0	29.6	28.2	1.4
Controls (Chlorotic) [2]	8.1	20.0	15.6	4.4

[1] Mean of 5 plants
[2] Mean of 10 plants