locations gave good control. Phosdrin, malathion-perthane, and thiodan gave promising results. Two applications of endrin at 0.2 pound per acre application at 10 to 14 day intervals before cabbage plants begin to head followed by parathion at 0.37 pound per acre application at seven day intervals is recommended to Florida growers for cabbage caterpillar control.

LITERATURE CITED

GIBBERELLINS — RESEARCH AND POSSIBLE APPLICATIONS TO FLORIDA

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You have heard of the beginning of the gibberellin story, and you have seen how the use of the material developed and interest grew. Some of its apparent functions have been discussed and a comparison made with other growth regulating substances. You have also seen the results of specific researches on vegetable crops here in Florida. Such a material, with the attendant public attention, has, of course, been the subject of much research. Let us look at some of the results of those researches that, after additional study, might be applied to Florida agriculture.

Seed Treatments. — There have been numerous reports on seed germination. Harrington (3) has found an increase in the rate and percentage germination of tomato seeds in cold soil (50 and 59°F.) after soaking in gibberellins. It was also found that bean and celery seed germination was hastened but no effect was found on onions, asparagus, cabbage, broccoli or carrots. Wittwer and Bukovac (18) have reported increased vegetative growth of numerous plants, including celery (petioles), beans, and broccoli. In those plants such as lettuce and endive, where bolting and flowering occurred, the seed stalk was elongated. Marth et al (10, 11) reported heights of snapbean, pepper, and eggplant doubled or tripled by a 1 per cent lanolin paste application. Fresh and dry weights were increased during early stages of growth. Rappaport (13) reports a decreasing response of tomato plants to the same dosage as the plants add more leaves. Tomato plants harvested 20 days after the first true leaves were treated increased in fresh and dry weight by about 40 per cent over untreated plants. It is apparent from work that has been done that response to applications of gibberellins varies with plants

or even varieties of the same plants, age of plant, dosages and many environmental factors. The general growth response has been internodal elongation, with varying effects upon leaf size and form. Indications are that length, weight, and number of roots are reduced, although there are reports of increased root growth (5, 16, 17).

Flowering. — Flowering responses to gibberellins have been of two general types. One is that associated with what may be called normal flowering under conditions not normally conducive to such flowering. Those cases falling into the latter category are of particular interest to plant breeders and seed producers. Wittwer and Bukovac (19, 20) report several long-day annuals produced flowers when grown under short-day photo-periods and treated with gibberellins as a single foliar spray of 100 or 1000 ppm or 20 to 100 mg per plant applied at various seedling stages. Bibb and Great Lakes lettuce, endive, mustard and spinach required repeated treatments. Flowering of this type of plant grown under conditions conducive to flowering and treated with gibberellins has been earlier than for control plants. They also report (1, 20) some gibberellin substitution for a cold period. Harrington et al (4) reported responses of vernalized and non-vernalized endive to gibberellin treatment. Some vernalized and treated plants, however, failed to develop seed, although flowering occurred. Rappaport (13, 14) has caused tomatoes to flower 3 to 10 days earlier, depending on variety, by gibberellins. The number of nodes preceding flowering was unchanged or slightly increased. He has not observed any effect on flower numbers in Earlypak variety.

In general, the effect of gibberellin, where it has any effect, appears to be to decrease the time from seeding to flowering by an increased growth rate and not because of any effect on flower formation. Here, again, reported effects vary, depending on many factors.

The California workers (13) have observed increased fruit set on tomato clusters; however, fruit size was decreased and much of the fruit was unsalable. Parthenocarpic fruit often resulted. Percentage of puffy fruit was reduced by flower cluster sprays and most fruit appeared salable. Parthenocarpic fruit development following gibberellin spray of 10 ppm has also been reported from Michigan (22). Other information concerning yields and quality of vegetable crops is comparatively lacking. Morgan and Mees (12) indicate yields of tomatoes and beans were not increased when plants were sprayed with gibberellins during flowering or early fruit set. They also report yields of potatoes, turnips and carrots were reduced even though vegetative growth was increased. Yields of crops in which seeds were treated were not reported or were indicated as non-affected.

Other Effects. — Perhaps the most familiar other effects of gibberellin has been its effect on dormancy or rest period. Lockhart
(9) has reported the use of gibberellins to restore the growth rate of peas inhibited by red light. Johnson and Liverman (6) and Liverman and Johnson (8) have shown gibberellins to be effective in restoring more normal growth to summer tomatoes by reversing the inhibitory effects of far-red radiation. The major effect was on stem elongation and fruit enlargement. Concentrations of gibberellins of 250 mg, per liter sometimes, however, produced fruit injury.

The effect of gibberellin on the rest period of newly dug potatoes is of perhaps the most interest here, however. Rappaport et al (13, 15) used newly dug White Rose, Kennebec and Russet Burbank potatoes dipped for 5 or 90 minutes in solutions of 50, 500 or 2000 micrograms of gibberellin per milliliter. Sprouting was accelerated 2 to 3 weeks. Varietal differences were observed. Their preliminary work indicated gibberellins did not overcome the effects of maleic hydrazide applied to mother plants 3 months earlier. Dr. Rappaport (13) has indicated that they now feel that the lowest concentrations of gibberellin they have used (0.5 ppm) is equally effective in breaking the rest period, whereas it was previously thought 500 ppm would be required. The 0.5 ppm concentration did not produce the undesirable morphological effects.

SUMMARY

The effects of gibberellins on vegetable crops obtained by research in other areas with possible applications to Florida have been discussed. Typical research has been reported concerned with the effects of the material on seed germination, seedling growth, general growth responses, flowering, fruiting, crop yields, and the effects on dormancy and "rest periods."

From the results of these researches it becomes apparent that many factors are involved in the response of crop plants to applications of gibberellin. It is also apparent that there are many established effects that could be of importance to Florida vegetable growers. There remains, however, much additional research on the control of the many factors involved. This would include the relationship of possible benefits with current practices of fertility, and the effects of gibberellin on germination, transplanting, growth, flowering, fruiting and quality of the ensuing products.

LITERATURE CITED