cronutrients were removed. The concentrations of nutrients in the fruit from this area were about the same magnitude as macro- and micro-nutrients found in the peel and juice of fruit harvested from many other citrus-producing areas in California. Based on fresh weight of fruit, comparison of these values with those obtained in Florida show that higher amounts of nitrogen, calcium, and boron, and lower amounts of zinc and manganese were removed by fruit in California. The amounts of phosphorus, potassium, magnesium, copper, and iron were about the same in California as those reported in Florida.

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Control of PYTHIUM ROOT ROT IN CARNATIONS

TABLE 1. CONTROL OF PYTHIUM VEXANS ON CARNATION PLANTS AS MEASURED BY PLANT GROWTH

Treatment	Rate of Active concentration	Equivalent concentration	Tops		Roots
			Net wt	Dry wt	Dry wt
			gr	gr	gr
Infested mix	PPM	per cu yd†	45	6.7	1.00
Infested mix + ethazol	50	4⅓ oz*	64	8.6	.91
Infested + diazoben	25	1⅞ oz‡	64.5	9.1	1.55
Infested mix + diazoben + PCNB	25 + 25	1⅞ oz, ⅞ oz	72.5	10.8	1.71
Non-infested mix			68	9.8	1.26

* 30% material.
† Based on weight of moist planting mix at 60 lb/cu ft.
‡ 35% material.

TABLE 2. EFFECT AND CONTROL OF PYTHIUM VEXANS ON CARNATION PLANTS

Treatment	Rate of concentration	Equivalent concentration	Tops		Roots	
			Height	Dry wt	Dry wt	Net wt
			inches	gr	gr	gr
Infested mix			46.1	27.33	5.96	.76
Infested mix + diazoben weekly	100 ppm	4 oz/100 gal	61.5	63.53	10.16	.74
Infested mix + ethazol	50 ppm	4⅓ oz/cu yd	53.6	51.55	9.92	.79
Infested mix + propylene oxide			58.7	60.17	12.21	.88
Non-infested mix			60.1	61.26	12.49	.95

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These tests showed that when Pythium vexans (isolated from carnation roots) was introduced into soil mixes, it reduced the top growth and yield of Red Sim carnations. No other symptoms were visible on the plants. Control measures using ethazol as a preplant at 50 ppm, diazoben as a preplant at 25 ppm, or diazoben as a drench at 100 ppm at weekly or biweekly intervals also gave control. The ethazol preplant and diazoben drenches at weekly or biweekly intervals may be slightly toxic. Additional experiments on control are in progress.

THE WATER MOLD FUNGI (*Pythium* and *Phytophthora* sp.) are known to attack many plants and cause damage ranging from slight injury to death of the plants. *Phytophthora* sp. have been reported as damaging carnations but little has been reported regarding the effects of infection of these plants by *Pythium* sp. Since *Pythium vexans* has been isolated from roots of carnation plants not appearing to be adversely affected, this study was initiated to determine the effect of this fungus on the growth of carnation plants.

U.C. mix was infested with fungus grown in pure culture on autoclaved millet seed. Prior to use, some of the infested mix was treated with ethazol [5-ethoxy-3-trichloromethyl - 1,2,4-thiadiazole] at 50 parts per million (ppm) active ingredient, some was treated with diazoben [p-(dimethylamino) benzene-diazo sodium sulfonate] at 25 ppm active and some was treated with diazoben plus PCNB (pentachloronitro benzene) each at 25 ppm active. The mixes were put in pots and 10 pots of each treatment were planted with Red Sim carnation plants. In addition, 10 plants were planted in infested mix to which no fungicide had been added, and 10 plants were planted in non-infested U.C. mix. Approximately three months later, the plants were harvested and the weights of the tops were determined. The tops and the roots were oven-dried and weighed. The results are given in table 1.

In this experiment it was found that all treated plants grew better tops than those grown in the infested mix. All of the root systems except the ethazol treatment were larger than those from the infested mix. The tops of the plants grown in the mix treated with ethazol weighed more than the the tops from the infested mix, indicating the disease was controlled. A decrease in the size of the root system was interpreted as the result of a slight toxicity from a high rate of application. Soil treated with diazoben and diazoben plus PCNB produced better plants than the non-infested mix, suggesting that there may have been some contamination of the non-infested mix after planting. The fact that treatments with PCNB added to diazoben resulted in better plants than treatments with diazoben alone suggests that *Rhizoctonia* might also have been introduced as a contaminant.

Another experiment was then started using similarly infested U.C. mix. Some of the infested mix was treated with ethazol at 50 ppm active. Some was fumigated with propylene oxide to kill the fungus and in this way check the effect of the millet seed in the mix. Fifteen plants each of Peterson's Red Sim were planted in pots for each treatment. In addition, 30 plants were planted in infested mix and 15 of these were drenched with ethazol weekly at the rate of 100 ppm active. Fifteen were also grown in the infested mix, and 15 were grown in non-infested mix. After two months, no differences could be detected between the plants growing in treated and non-treated mixes, except the plants in the latter were shorter and did not have as many side branches (see photo 1). At this time the heights

Control of Pythium vexans in carnations. In A, B, C & D, plants are growing in infested soil mix. In A, there was no treatment; in B, soil mix treated with ethazol prior to planting; in C, soil mix was treated with diazoben prior to planting; and in D, soil mix was fumigated with propylene oxide prior to planting. In ck (check), plants were planted in non-infested soil mix.

were recorded and the wet weights of the tops were determined. The tops and the roots were then oven dried and weighed (data in table 2).

All plants grew better and produced better tops in this than those in infested, non-treated mix, indicating disease control. The root weights of the treated plants were about the same as the root weights of the non-treated plants, however, suggesting there might be some toxicity at the rates used. The root systems of plants grown in the non-infested mix, or in the mix where the fungus was killed, were larger.

The preceding experiments showed that control of *Pythium vexans* increased growth of the tops of the plants, but they indicated nothing about flower production. For this information, a yield trial was started in which plants were grown in infested U.C. mix. To show whether the controls would work in other growing media, plants were also grown in Colma sandy loam. The mixes were infested with the fungus on millet seed. Some of each mix was treated with ethazol at 50 ppm. After planting with Peterson's Red Sim, some plants in each mix were drenched with diazoben at weekly and biweekly intervals. Plants were grown also in infested mixes and in non-infested mixes. Fifteen plants were used in each treatment in the U.C. mix and 10 plants were used in each treatment in the sandy loam. Plants were grown three months and yields were taken. Plants were then harvested, and the tops were cut, dried and weighed (results in table 3).

In this experiment, it was found that control of *Pythium vexans* in U.C. mix and sandy loam by weekly or biweekly applications of diazoben resulted in increased weight of tops and more flowers. Ethazol, applied pre-plant, gave the best top growth but resulted in fewer flowers. This was possibly a slowness in flowering resulting from the larger number of side shoots produced. Had the experiment run longer, more flowers would have been produced. The numbers of flowers in both mixes were comparable, but (for reasons unknown) the top growth was larger in the U.C. mix.

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TABLE 3. EFFECT OF PYTHIUM VEXANS AND ITS CONTROL ON GROWTH AND YIELD OF CARNATIONS IN TWO SOIL MIXES

Treatment	Dry weight of tops		Flowers per plant	
	U.C. mix	Sandy loam	U.C. mix	Sandy loam
	grams		Avg number	
Infested	5.60	4.48	2.3	2.5
Infested + diazoben weekly*	9.38	5.88	3.0	3.2
Infested + diazoben biweekly*	9.41	6.03	3.5	3.1
Infested + ethazol†	9.70	6.19	2.8	1.9
Non-infested	9.03	7.62	3.2	3.3

* Drenched at 100 ppm = 4 oz/100 gal.
† Preplant at 50 ppm = 4⅓ oz/cu yd.

TABLE 1. AVERAGE AGE AT FIRST EGG AND TOTAL EGG PRODUCTION IN BROAD BREASTED WHITE HENS GIVEN STIMULATORY LIGHT (16L:8D) AT DIFFERENT AGES FOLLOWING A PERIOD OF 6 WEEKS LIGHT RESTRICTION (8L:16L)

Hatch no.	Date of hatch	No.	Age given light restriction*	AV. days to 1st egg	AV. age at 1st egg
			weeks	days	days range
1	1/20	62	24–30	25	235 (230–241)
2	2/3	43	22–28	27	223 (216–232)
3	2/17	19	20–26	27	209 (205–221)
4	3/3	41	18–24	29	197 (188–207)

* All birds given 8 hour light per day for 6 weeks and 16 hours light per day thereafter.

Results from this study indicate that best turkey egg production is obtained from winter-hatched poults that are stimulated to lay at about 30 weeks of age following an exposure to 6 weeks of restricted light. Hens given stimulatory light earlier (at 24 and 26 weeks of age) produced fewer and smaller eggs over a 20 week period of lay. These younger hens also tended to pause more frequently than older hens, and a greater percentage of the younger birds terminated egg production prematurely. It was of interest to note that approximately 54% of the hens in hatch 4 did not pause in lay at any time during the 20 weeks of lay, as compared with 77% of the hens in hatch 1. The incidence of pausing, irrespective of age of the hen, also appears to be concentrated in certain families within this study. The trait of broodiness has been greatly reduced in certain strains of chickens and small breeds of turkeys. Consequently similar genetic gains in decreased incidence of pausing can be anticipated in medium-to-large strains of turkeys. Thus increased rates of lay through improved genetic control of pausing may make it possible and economically profitable to supply light to hens before 30 weeks of age.

TABLE 2. AVERAGE EGG PRODUCTION IN B.B. WHITE HENS GIVEN STIMULATORY LIGHT AT DIFFERENT AGES

Hatch	Age at lighting	Period of production	
		10 wks	20 wks
	weeks	no. eggs	
1	30	47.3	86.5
2	28	43.2	80.6
3	26	41.3	70.2
4	24	43.0	78.2

TABLE 3. THE INCIDENCE OF PAUSING IN B.B. WHITE HENS GIVEN STIMULATORY LIGHT AT 30, 28, 26 AND 24 WEEKS OF AGE

Hatch no.	Hens	Duration of pauses		Hens showing pauses
		Period of production		
		1 to 12 wks.	13 to 20 wks.	
	no.	days	days	%
1	62	19.6	19.8	22.6
2	43	16.4	32.1	32.6
3	19	30.2	39.1	57.9
4	41	23.5	35.6	46.3

LIGHTING TURKEYS FOR OFF-SEASON EGG PRODUCTION

ALLEN E. WOODARD · HANS ABPLANALP

UNDER NATURAL CONDITIONS turkey poults are hatched in late spring and reared during the summer and early fall. The hens approach sexual maturity at 7 months of age, but are inhibited from laying eggs by the naturally shorter day-length at that time of year. Only after the natural daylight reaches about 12 hours (in mid-March), will the hens begin to lay.

Using artificial light in controlled chambers, researchers have been able to demonstrate that sexual response in turkeys is dependent upon two essential factors associated with photoperiod. In order to induce maximum rates of lay hens must (1) undergo a period of preconditioning under a short daily light increment prior to reaching the age of sexual maturity. This short-day light period must then be followed by (2) stimulatory conditions of long or increasing day lengths. Failure to precondition turkey hens under short-day light conditions results in erratic onset of lay and unfavorable rate of lay thereafter. Such adverse reactions are encountered in the field when poults are hatched out of season during the fall or early winter months. However by means of artificial darkening in closed houses during the spring, turkeys hatched in the fall can be induced to lay during the summer and fall after receiving and being maintained under stimulatory light.

Recent evidence indicates that uniform sexual maturation of fall and winter hatched turkeys can be obtained by holding the hens under short daylight (about 6 hours light and 18 hours darkness per day) for from 6 to 8 weeks. Following such a preliminary treatment most hens will begin to lay within 3 to 4 weeks if given 12 hours or more light per day, provided they are old enough to lay.

Large strains

Because large strains of turkeys are expensive to maintain, much interest has recently developed in inducing hens to lay at the earliest possible age while maintaining high reproductive performance later on.

In this study, four age groups of medium size Broad Breasted white turkeys, hatched at 2-week intervals (hatch 1—Jan. 20; hatch 2—Feb. 3; Hatch 3—Feb. 17; and hatch 4—March 3, 1971) were reared in open range pens under naturally increasing daylength to July 7. At that time the hens were 24, 22, 20 and 18 weeks of age and were randomly assigned to individual cages in an enclosed house, and were then given restricted light of 6 hours light and 18 hours darkness per day for a period of 6 weeks. Beginning Aug. 6, the hens were then given long days of 16 hours light and 8 hours darkness. At the onset of this long-day treatment the hens of the four hatches were 30, 28, 26, and 24 weeks of age respectively.