Table 9. Effect of 3-CPA on yield of 'MH-1' tomatoes.

3-CPA concn (ppm)	Harvest date 6/21	6/27	7/5	Total
	Yield (MT/ha)			
0	12.5	12.4	23.3	48.2
250	11.0	10.5	23.6	43.9
500	13.5	11.4	18.4	43.4
1000	14.1	11.2	18.9	41.8
	NS[z]	NS	NS	NS

[z]Not significant (NS).

although there was a trend towards lower yields from the second and third harvests. This was coupled with a slightly higher yield from the 500 or 1000 ppm treatments on the June 21 harvest date.

Fruit size was increased in all crops tested except watermelon and the dwarf muskmelon. Apparently, the increase in size was accomplished by a reduction in the total number of fruit which reached maturity on each plant. At the time of 3-CPA application to watermelon, only one female flower had opened and set. 3-CPA does not translocate much after it is applied (3), thus, abortion of subsequent female flowers probably did not occur. The chemical greatly increased fruit size of normal vine types of muskmelon but was without affect on the dwarf line. The 77-11 line is known to have smaller fruit size than the normal vine types. As with watermelon, CPA was probably without effect on muskmelon because it was not applied at such a time as to remove recently pollinated flowers. Also, the fruit number per plant on the non-treated plants was less on the dwarf (3.2) than on the normal (4.9).

Thus fruit size may be increased in several crop species by application of the growth regulator 3-CPA. The increase in fruit size may not be as desirable in crops such as muskmelon (except in the dwarf lines) however this would be highly desirable in other crops such as tomato which are priced by size.

In these experiments, tomato fruit size was significantly increased at all three harvest dates, yet yields were unaffected. Tomato plants commonly produce many more fruits than are needed to obtain satisfactory yields, thus the removal of late setting flowers can be highly desirable to increase fruit size and profits. This was likewise true with the peppers.

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FLUID DRILLING OF PREGERMINATED PEPPER SEED[1,2]

H. H. Bryan, F. A. Maas and Mary Sherry
University of Florida, IFAS
Agricultural Research and Education Center,
18905 SW 280 St.,
Homestead, FL 33031

Additional index words. Capsicum annum, biostimulant, emergence.

Abstract. **Pepper (Capsicum annum L.) seed germinated earlier and more uniformly in solutions that contained alpha keto acids, cytokinins and humic acids than in water alone. Seedling growth was also enhanced by their addition to gels at planting. In wet conditions, nonimbibed seed emerged later when in gel than without gel; pregerminated seed emerged earlier in gels in the presence of biostimulants than seed in gels without biostimulants and attained a level of emergence comparable to seed without gel. In dry conditions pregerminated seeds emerged earlier in the presence of gel than in its absence and unimbibed seed and seed pregerminated in water had emergence delayed considerably longer than seed pregerminated in biostimulant solutions.**

Adverse conditions for seed germination often result in delayed and irregular emergence of seedlings. The use of pregerminated seed is an alternate sowing method that has potential to produce more uniform seedling emergence, thus possibly more harvest.

Fluid drilling of pregerminated seed is a system that involves seed germination in controlled moisture, air and temperature; separating of germinated from ungerminated seed; mixing germinated seed with a gel carrier and sowing the seed-gel mixture with a fluid drill planter. Fluid drilling of pregerminated seed, or gel-seeding, is a method that reduces field seeding problems caused by unfavorable weather conditions before and after planting (2, 3, 4). Tomato plant emergence and yield of marketable fruit have been improved by using growth regulators and fungicides as gel additives (5). Early emergence and enhanced seedling growth was observed on several small and large seeded vegetables fluid drilled with biostimulant gel (biogel) additives (1).

Most of the 20,000 acres of Florida bell peppers (*Capsicum annum* L.) are grown on plastic mulch. Uniform seedling emergence and concentrated early yields are difficult to attain during adverse weather, but are essential to increase the likelihood of a reasonable profit.

The objectives of this research were to determine effects of additives to gels and fluid drilling on emergence and early plant growth of peppers.

Materials and Methods

'Early Calwonder' bell pepper seed were used to determine optimum biostimulant (bio) rates in solutions for accelerating germination and also for subsequent tests to evaluate effects of sowing pregerminated seed and biogel additives on seedling emergence and growth. Gels of 1.5% (weight/volume) were made with Laponite 508 gel powder

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[2]Authors wish to acknowledge assistance of American Colloids, A. and P. Research, Inc., Cytozyme Labs, Inc., Fluid Drilling, Ltd., Natural Earth Products, Inc., Montedison, Laporte U. S., and Peto Seed Co.

with no additives and up to 2% when using additives. Gels were made before adding the biostimulants. Bioadditives for germination solutions and for gels were alpha keto acids (Natural Earth Products); cytokinins (Atlantic and Pacific Research, Inc.); cytokinins + micronutrients (Cytozyme Labs, Inc.); humic acids (American Colloids Co.) an n-acetyl thiozolidin + folic acid (Montedison) (Table 1). The first 4 additives were tested during June and July 1981, during which daily watering produced slight water stress, and the fifth was included during May and June 1982 with excess watering (2 to 3 times daily).

Germination. Optimum biostimulant rates for germination based on speed and uniformity of 'Early Calwonder' pepper germination (radicle emergence) at 25°C are shown in Table 1. Seed samples for the 1981 and 1982 tests were placed in 4.3 liter columns with filtered aeration, 25°C and a water exchange rate of 1 liter per hr for 24 hr. After this, water exchange was stopped, 0.5 ml antifoam agent and optimum amounts of biostimulants were added to the aerated columns.

Seedling emergence. Seed which were germinated in water or in biostimulant solutions were sown into moist peat-vermiculite medium in styrofoam flats with 128 cells per flat. Each plot consisted of 16 cells, 2 rows with 1 unplanted row between plots. Five seeds were planted in each 37 x 37 mm cell. Plots with gel treatments received 5 ml gel per cell. Factorial treatments consisted of 3 seed treatments: nonimbibed seed, seed pregerminated in water and seed pregerminated in various biosolutions; 3 gel treatments: no gel, gel only and biogels. Each biostimulant combination was analyzed separately in a 3 x 3 factorial analysis of variance (3 seed treatments x 3 gel treatments), and Duncan's multiple range test or Tukey's HSD test was applied to the data where significance was indicated. Treatments were replicated 3 times in 1981 when moisture conditions were adequate and 4 times in 1982 when conditions were wet.

Seed were sown June 17, 1981 and May 17, 1982. Emergence data were recorded every 2 to 3 days for 3 wk and in 1981 10 plants per plot were cut at soil level for dry weight, in 1982 only 5 plants per plot were sampled.

Results and Discussion

Germination. Optimum biosolution rates for germination accelerated germination in aerated columns at 25°C to 48 to 74% radical emergence compared to 4% emergence in water alone after 112 hr (Table 1).

Seedling emergence. In 1981, with adequate moisture conditions and daily temperatures ranging from 21-24°C to 30-35°C, seed germinated in biosolutions with a) alpha keto acids (AY) sown with gel, b) cytokinins (CX) sown with biogel containing cytokinins, and c) cytokinins + micronutrients (CZ) sown with biogel containing the same additives attained 50% emergence earlier than nonimbibed seed (Fig. 1). Sowing nonimbibed seed or seed pregerminated in water with gel or with biogels did not accelerate time to 50% emergence. However, 8 days after sowing seed pregerminated in water attained a higher emergence percentage than nonimbibed seed and percent emergence was further enhanced by germinating seeds in biosolutions containing alpha keto acids (AY), cytokinins (CX), cytokinins + micronutrients (CZ) and humic acids (AL) (Fig. 2).

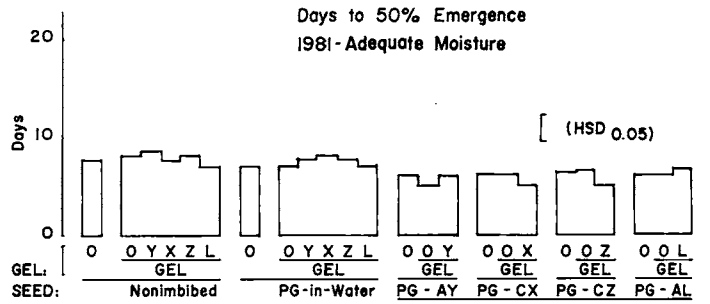

Fig. 1. Effects of seed treatment and gel treatment on days to 50% emergence with adequate moisture conditions. 1981. PG = pregerminated seed; 0 = no gel; O = water-gel; Biogels Y, X, Z and L and Bio solutions AY, CX, CZ and AL—see Table 1.

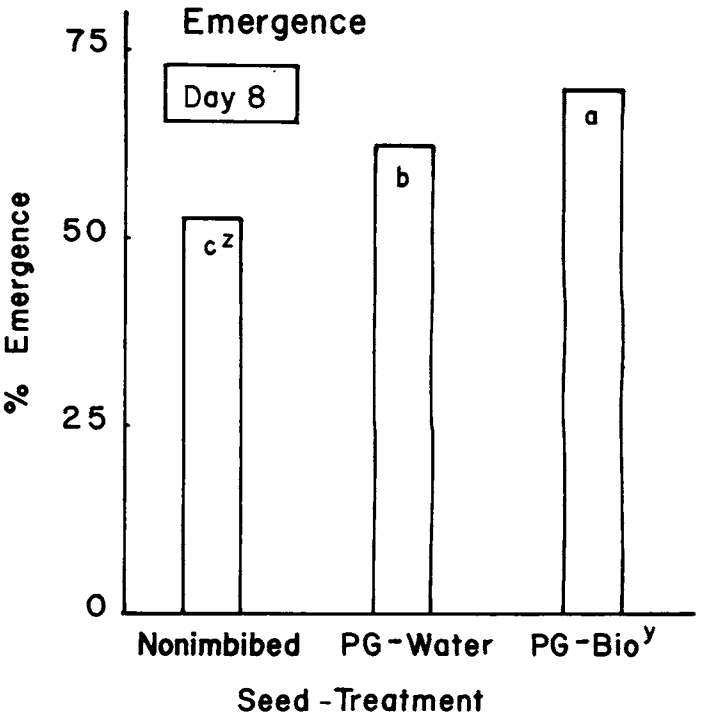

Fig. 2. Main effect of seed treatment on emergence of pepper 8 days after sowing. 1981.
zMean separation by Duncan's multiple range test, 1% level.
yMean of PG-AY; PG-CX, PG-CZ and PG-AL. (See Table 1).
PG = pregerminated.

Table 1. Biostimulants: Active ingredients, rates and symbols for germination solutions, gel additives and percent germination after 112 hr in the germination columns at 25° C, 1982.

Biostimulant		Symbol	Biosolution (% w/v)	Biogel (% w/v)	Germination (112 hr) %
Chemical	Name				
Water		W			4 b
Alpha keto acids	AG-50Y	AY,Y	0.2	0.8	74 a
Cytokinins	Cytex	CX,X	0.1	0.25	68 a
Cytokinins + micronutrients	Cytozyme	CZ,Z	0.1	0.1	48 a
Humic Acids	Agro-Lig	AL,L	0.04	0.1	62 a
N-acetyl thiozolidin + folic acid	Ergostim	ER,E	0.25	0.1	59 a

In 1982, with temperatures similar to 1981 and with wet moisture conditions, gel mixed with nonimbibed seed or with seed pregerminated in water resulted in a slower emergence rate and low emergence levels 11, 15 and 21 days after sowing compared to similar seeds planted without gel (Fig. 3). Seed pregerminated in cytokinin (Cytex) solution

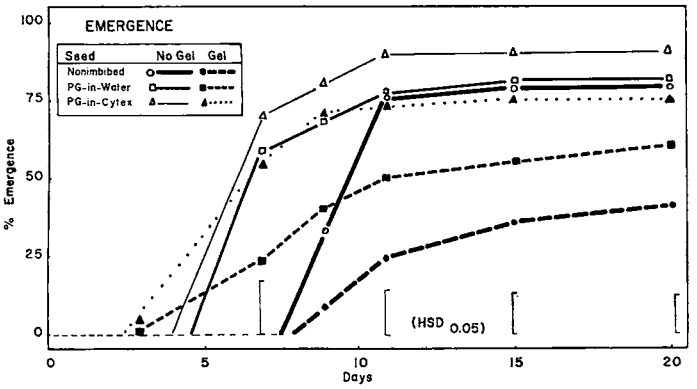

Fig. 3. Effects of seed treatment and gel treatment on seedling emergence in wet conditions, 1982 Biogels were not shown to illustrate the marked effects of gel vs no gel effects on seedling emergence. PG = pregerminated.

and planted in gel had a higher emergence rate and attained a higher emergence percentage 7, 11, 15 and 21 days after sowing than other seed sown with gel. Seed germinated in cytokinin solution and sown with gel also had the earliest emergence and 11, 15 and 21 days after sowing was compared to that of seed planted without gel.

Gel is essential in the sowing of pregerminated seeds to reduce mechanical injury to the exposed radical. In wet conditions, aeration was limited and sowing in a gel became an adversity, especially when seed 1) was nonimbibed and a longer time was required for initial emergence or 2) was pregerminated-in-water which may have leached out endogenous essential nutrients, thus creating a weakened condition. However, seed germinated in a cytokinin solution showed improved vigor of germinating seed, thus enhancing their ability to withstand adverse conditions—in this case, wet media conditions in the presence of gel which was essential to reduce mechanical injury during sowing.

Nonimbibed seed planted without gel required less than half the time to attain 50% emergence than similar seed planted with gel regardless whether or not biostimulants were added to the gel (Fig. 4). Seed pregerminated in water

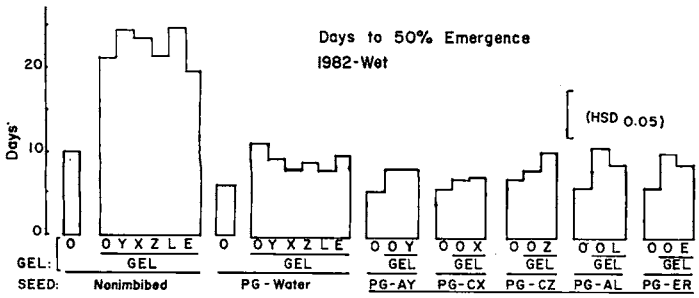

Fig. 4. Effects of seed treatment and gel treatment on days to 50% emergence during wet conditions 1982. PG = pregerminated seed; 0 = no gel; O = water-gel; Biogels Y, X, Z, L, and E and Bio solutions AY, CX, CZ, AL and ER—see Table 1.

had earlier emergence than nonimbibed seed and seed pregerminated in biosolutions, especially alpha keto acids (AY) and Cytokinins (CX), required the shortest time to reach 50% emergence.

Interaction of seed and gel treatments with alpha keto acids on seedling emergence during wet conditions showed that 1) without gel, early emergence (7 days) was greater with pregerminated seed than with nonimbibed seed and emergence after 21 days was similar whether or not seed were pregerminated; 2) with gel alone, percent emergence at 7 and 21 days was highest from seed pregerminated in alpha keto acids solution, followed by seed pregerminated in water; 3) with gel containing alpha keto acids, pregerminated seed regardless of germinating solution attained a higher percent emergence than nonimbibed seed (Table 2).

Table 2. Interaction of seed treatment and gel treatment on the percent emergence 7 days and 21 days after sowing, 1982.

	Non-imbibed		Pregerm. in water (days)		Pregerm. in biostim.z	
	7	21	7	21	7	21
0	0	80	59	78	59	80
Gel	0	42	25	58	40	72
Gel + biostim.	0	42	47	70	42	71

zBiostim. = biostimulant alpha keto acids.

When seed were pregerminated in water, emergence was enhanced by using the biostimulant in the gel; when seed were pregerminated in biostimulant solution emergence was similar whether the biostimulant was included in the gel or not. Thus, emergence, of pepper seedlings was improved by including alpha keto acids in either the germinating solution or the gel, but not additional advantages was attained by including it in both the germinating solution and the gel.

Plant growth. Plant growth was not affected by interactions between seed treatments and gel treatments during 1981 with adequate watering. Plant dry weight was affected by seed treatments with alpha keto acids; cytokinins, cytokinins with micronutrients and humic acids in a similar way. When planted with biostimulant gels, early growth was greater with plants from seed pregerminated in biostimulant solutions than those pregerminated in water or nonimbibed seed (Fig. 5). The biostimulant solution treatments combined with biostimulant gels resulted in larger plants than did either nonimbibed seed or seed pregerminated in water when used with biostimulant gel additives. Daily growth rates between the 23rd and 37th sampling dates averaged 2.5 mg/plant/day for seed planted dry compared to 3.5 for seed pregerminated in water and 4.2 for seed pregerminated in biostimulant solutions. These had 40% and 68% greater growth rates, respectively than from nonimbibed seed.

Twenty-eight days after sowing in the wet conditions of 1982, plant dry weight was 42 and 32% greater in plants from seed pregerminated in biostimulant solutions and in water, respectively than in plants from nonimbibed seed (Fig. 6).

In conclusion, with excessively wet conditions, gels had adverse effects on seedling emergence, ultimate stand and plant weight, which could be overcome by use of biostimulants (alpha keto acids, cytokinins without and with micronutrients, humic acids and n-acetyl thiozolidin + folic acid) in either the germinating solution or as additives to the gel. Planting systems that require gels for sowing pregerminated seed will be more effective under various conditions with the use of biostimulants in the germinating solution or as gel additives. All the biostimulants tested were effective in improving emergence and increasing weight of plants from pregerminated seed compared to nonimbibed seed.

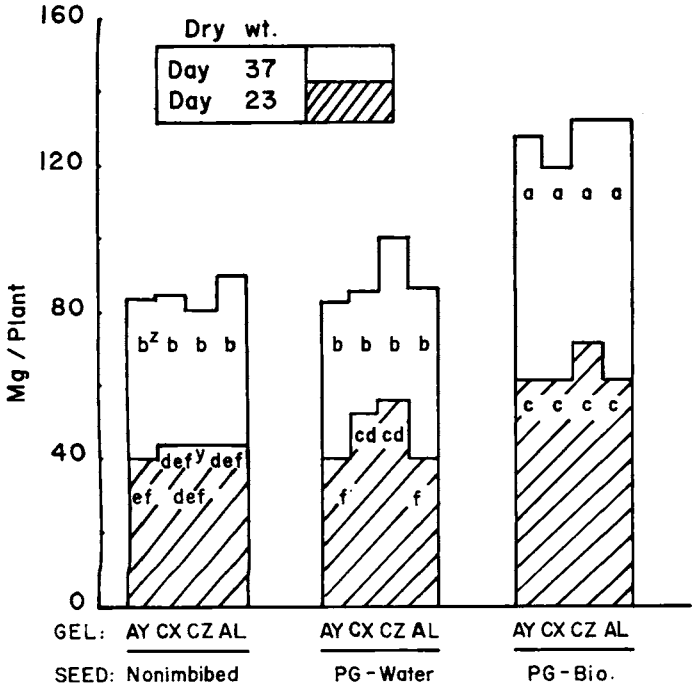

Fig. 5. Effects of seed treatment and biogels on dry weight of pepper plants 23 and 37 days after sowing. 1981. PG = pregerminated; AY, CX, CZ, AL see Table 1.
PG = pregerminated AY, CX, CZ, AL see Table 1.
z,yMean separation within days by Duncan's multiple range test, 1% level, PG = pregerminated.

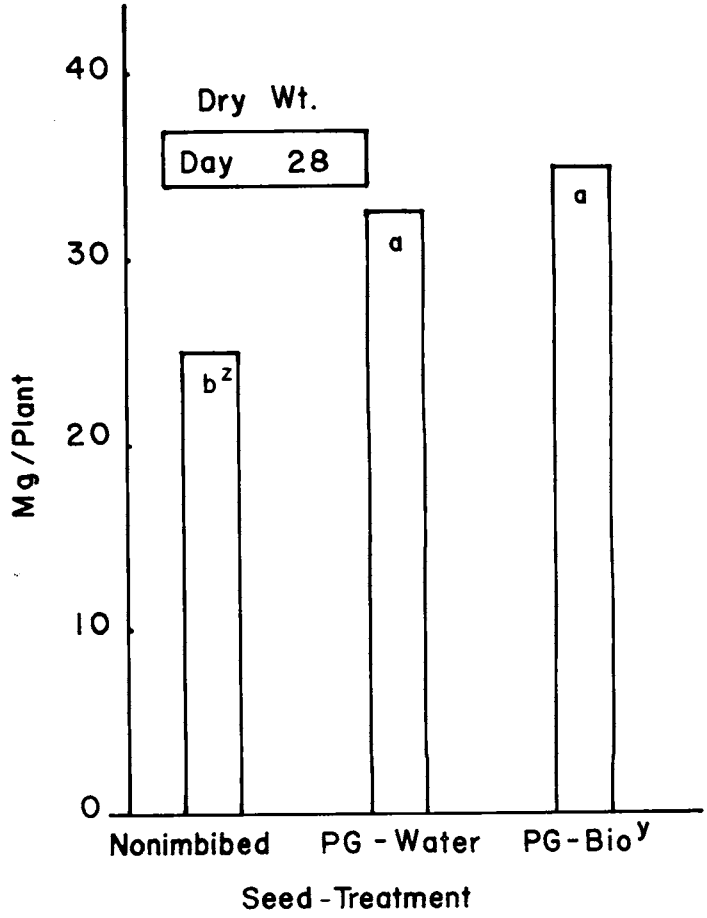

Fig. 6. Effect of seed condition on dry weight of plants 28 days after planting. 1982.
zMean separation by Duncan's multiple range test, 1% level.
yMean of 5 bio solutions (See Table 1).

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EFFECTS OF UV-B IRRADIATION ON GROWTH AND DEVELOPMENT OF DIFFERENT VEGETABLE CROPS

FOUAD M. BASIOUNY[1]
Department of Agricultural Sciences, Tuskegee Institute, Tuskegee Institute, Alabama 36088

Additional index words. light effect, atmospheric pollution, ozone depletion.

Abstract. **The effects of UV-B irradiance on growth and development of different vegetable crops were studied under greenhouse conditions. UV-B reduced plant height, fresh weight, dry weight and ash contents. The reduction varied among the different species tested.**

Since the discovery of the lethal effects of ultraviolet radiation on bacteria in 1866, many separate and distinct physiological, morphological, biochemical and genetical effects of this radiation have been recognized (3, 12, 21). Plant reactions to UV radiation have been the subject of considerable study. Experiments using an artificial UV source under controlled conditions have led to a great deal of speculation in areas where plants are subject to high UV intensities. Some investigators (4, 6, 7, 13) demonstrated substantial changes in plant growth and phenology under various types of UV filters (5, 13), while others showed deleterious effects of UV on a variety of higher as well as lower plants (7, 8, 10). Review of the literature discloses that there is a wide variety of morphological and/or physiological phenomena which may result from exposing plants to UV. It has been suggested that damaging effects on plant cells are mainly due to changes in proteins and

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