Stimulating the Sprouting of Yam Tubers with Ethephon[1]

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ABSTRACT

Treatment of pieces of tuber of *Dioscorea alata* with ethephon promoted early sprouting. Effective dilutions varied from 0.08 to 1.28%. No toxic effects occurred at the highest concentration. Treatments were most effective early in the season but were also useful later even though natural sprouting became imminent. In comparison with recommended levels of ethylene chlorohydrin, ethephon stimulated sprouting equally. The maximum savings of time due to ethephon treatment was about 3 weeks.

INTRODUCTION

Yam (*Dioscorea* spp.) tubers are underground storage organs facilitating dormancy and survival in areas with alternating seasons of rain and drought. The lengths of seasons of growth and dormancy of yams are closely adjusted to seasonal changes and are not flexible. Physiological modification to suit the requirements of man is difficult. The dormant tuber does not readily sprout, except at the end of its normal period of dormancy. Only to a minor extent can sprouting be speeded up by early planting. Thus, the dormancy is a physiological character controlled by an inner timing mechanism and is best described as rest.

Often it is desirable to stimulate the sprouting of tubers or tuber pieces in order to plant earlier than normal or to increase the uniformity of sprouting. Ethylene chlorohydrin (2-chloroethanol) has proved to be a useful agent. It was first applied by Campbell et al.[3] and was later used by Cibes and Adsuar[4] for preplanting treatment. Seed tubers were immersed in a 6% solution of this substance with 1% thiourea for 5 min. Treated yams sprouted several weeks before normal and more uniformly. However, ethylene chlorohydrin is toxic to plant tissues, and the dosages used to stimulate sprouting are sometimes injurious. Less risky treat-

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[3] Campbell, J. S., Chukwekl, V. O., Teriba, F. A., and Ho-A-Shu, H. V. S., Some physiological investigations into the White Lisbon yam *Dioscorea alata* L. The breakage of the rest period in tubers by chemical means, Emp. J. Exp. Agr. 30 (118): 108–14, 1962.

[4] Cibes, H. R., and Adsuar, José, Effects of 1-chloroethanol and thiourea on the germination and relative yield of the yam, J. Agr. Univ. P.R. 50 (3): 201–8, 1966.

ments are desired to accomplish the task required by the farmer. From preliminary experiments it was found that ethephon, (2-chloroethyl) phosphonic acid, stimulated sprouting without injury.

Tubers of cultivars Morado and Forastero were used in three experiments with ethephon. Ethephon was received as a solution of 4 lb/gal, but all concentrations given here refer to actual dilutions of the active ingredient.

In the first experiment eight concentrations of ethephon in water were applied to 10 tuber pieces of Morado soon after harvest. The tubers were cut to uniform size of 100 g and allowed to dry 1 day before treatment. They were soaked 5 min in solution, dried for 2 days, and then planted in a greenhouse bed. Response to treatment was measured as number of days to 50% tuber germination.

In a second experiment, tubers from one harvest were divided into groups of 10 pieces each of the previously used size, treated from 0 to 3 times at monthly intervals, and planted at the time of treatment or 1 or 2 months thereafter. All treatments consisted of immersing the tuber pieces 5 min in 0.4% solution. The pieces were dried before storage or planting. They were placed in common storage where temperature fluctuated from 20° to 28° C and relative humidity varied from 40 to 90%. Air circulated freely around the tuber pieces.

At the predetermined time the pieces were planted in the field, where they were irrigated and cared for normally. The percentage of pieces sprouted was calculated regularly.

A randomized block design with five replications and plots of 20 tuber pieces of Forastero was utilized for the third test. Treatments were immersion in 1% ethephon for 5 min or immersion 5 min in an aqueous solution of 6% ethylene chlorohydrin with 1% thiourea, as recommended by Cibes and Adsuar.[4] Tuber pieces were treated soon after harvest and planted immediately, about 2 months before the normal planting date.

Concentrations of ethephon as low as 0.08% stimulated sprouting of Morado seed pieces as shown in the following tabulation.

Percent concentration of ethephon solution	*Days to 50% sprouting*
2.56	33
1.28	38
.64	38
.32	37
.16	37
.08	38
.04	50
.02	50
.00	77

Little or no difference in sprouting can be attributed to differences from 0.08 to 1.28%. Therefore, a standard concentration of 0.4% was chosen for further experiments.

In the second experiment, where date of planting and time and frequency of treatment were varied, the effects of time alone were notable in the case of the untreated controls (table 1). The total time necessary for sprouting of 50% of the tuber pieces was apparently extended by a maximum of 11 days by delaying planting 2 months. The time necessary for 50% sprouting after planting was apparently decreased considerably by delayed plantings. The differences were not treated statistically.

These data show what has been observed for years, that storage of yam tubers breaks the rest period. If the tubers are not planted after the rest period is terminated, they will eventually sprout even without planting. Thus, the tubers of the first planting sprouted slowly and irregularly; those of the second, more rapidly and evenly; and those of the third planting, the most rapidly and uniformly.

Ethephon stimulated sprouting in all cases. The best measurement of this stimulation is the difference in number of days between planting and 50% sprouting. This difference, or time saving, ranged from 5 to 12 days (table 2). The largest difference occurred in the tubers planted earliest. In tubers planted after 1 or 2 months of storage, the greatest stimulation occurred when tubers were treated just before planting, or when treated two or more times.

The results of the third test, where ethylene chlorohydrin and ethephon were compared, are given in table 2. Both chemicals applied

TABLE 1.—*Number of days required for 50% of tuber pieces to sprout as influenced by planting date and number of 0.4% ethephon treatments*

Date of planting	Days for 50% of the tubers to sprout		
	Date of treatment	From start of experiment	From date of planting
Feb. 26	—	76	76
	Feb. 25	64	64
March 25	—	77	50
	Feb. 25	71	44
	March 24	71	44
	Feb. 25, March 24	70	43
April 25	—	87	30
	Feb. 25	81	24
	March 24	82	25
	April 24	78	21
	Feb. 25, March 24	78	21
	March 24, Apr. 24	77	20
	Feb. 25, March 24, Apr. 24	78	21

TABLE 2.—*Effect of ethylene chlorohydrin and ethephon on time to sprouting of yam tuber pieces*

Treatment	Time in days to level of sprouting indicated—		
	25%	50%	75%
Control	62	69	86
Ethylene chlorohydrin, 6% + thiourea, 1%	46	53	67
Ethephon, 0.4%	49	56	64

before an early planting date reduced sprouting time markedly. The amount of reduction in sprouting time to the point when 50% of the tubers sprouted was 13 days for ethephon and 16 days for ethylene chlorohydrin. Differences between treatments and controls were even more pronounced for 75% sprouting. Throughout the germination process, ethylene chlorohydrin and ethephon produced similar effects on sprouting. At first ethylene chlorohydrin appeared to be slightly superior to ethephon, but later the reverse appeared to be the case. However, the data were not treated statistically.

Although the rest period of yam tubers is a natural phenomenon associated with the yearly cycle, it is now obvious that it is subject to chemical controls. Simple treatments to reduce the time necessary for sprouting would increase uniformity of planting, thus simplifying cultural operations such as weed control. The use of ethylene chlorohydrin may be dangerous due to its toxic character. Ethephon, on the other hand, stimulates sprouting over a wide range of concentrations without injuring the tuber. The two materials appear to be similar in effect.

The effect of ethephon and ethylene chloride is to shorten the period of rest. By shortening this period, tubers also sprout more uniformly. In these experiments the time conserved in sprouting ranged from 12 to 48% of the total period for 50% sprouting (5 to 10 days). Although the data were not treated statistically, the differences have been consistent in all experiments. Our data contrast with those of Cibes and Adsuar[4] in that the reduction in sprouting time for ethylene chlorohydrin treatments in these experiments was less than they reported.

A reduction of sprouting time by 2 or 3 weeks is significant from a horticultural standpoint. Uniformity of sprouting simplifies farm operations and is especially advantageous in weed control. Stimulation of sprouting should also be useful when early planting is desirable in order to take advantage of favorable weather or when an effort is made to change the seasonal response of a variety. However, rapid and uniform sprouting can be achieved also by planting later, after the rest period is terminated.

RESUMEN

El tratamiento de pedazos de tubérculos de *Dioscorea alata* con Ethephon acortó el tiempo necesario para su germinación. Las concentraciones efectivas variaron entre 0.08 a 1.28 por ciento. No se observaron efectos dañinos ni aun cuando se aplicó la concentración más alta. Los tratamientos fueron más eficaces al comienzo de la temporada de siembra, pero el mismo efecto se notó también más tarde cuando ya el período de descanso se había acortado. Tanto el Ethephon como el etileno de clorhidrina estimularon la germinación de los tubérculos. Con el tratamiento más temprano se logró el brote 3 semanas antes de lo normal.