the host tree. Better control was achieved from the ester formulations of 2, 4-D than with the amine formulation with the same additives.

The additives, surfactants, dormant oil emulsion, dormant emulsive oil, and Volk oil, were used as aids to increase penetration of the herbicide into the foliage of the mistletoe and minimize penetration through the bark and into the host. The dormant oils appeared, in general, to be more effective than the surfactant.

Few symptoms of herbicide injury were evident in the host trees. An occasional growth regulator symptom was observed when treatments were made on young wood but never when treatments were made on old wood.

These experiments indicate that eradication will require several retreatments with herbicides. It would appear that the isopropyl ester of 2, 4-D, amitrole, or atrazine with dormant oil additives would give adequate control measures.

Amitrole, atrazine, and the isopropyl ester of 2, 4-D provided the most satisfactory control of mistletoe five years after treatment with no herbicide symptoms expressed on the host tree. The effect on the mistletoe is slow to be expressed and two or more years are required following treatment for the final effects to be evident.

Dormant oils appeared to enhance the penetration of the herbicide into the mistletoe without markedly increasing the penetration into the host tree.

Table 3.—Percent control of mistletoe growing on mature English walnut trees.

Herbicide	Additive	Percent Control 1962	1963	1964	1965
1961 treatment					
Ammonium sulfate		0	0	0	20
Maleic hydrazide		0	0	0	15
2, 4-D amine	Volk oil	100	0	0	0
1962 treatment					
2, 4-D isopropyl ester	Volk oil	67	50	58	50
Silvex	Dormant oil emulsion	69	38	15	23
1963 treatment					
2, 4-D isopropyl ester	Volk oil		86	36	29
Silvex	Volk oil		79	43	43
2, 4-D isooctyl ester	X-77			35	33
2, 4-D isooctyl ester				30	30
Silvex				27	18
Paraquat				44	33
2, 4-D isooctyl ester	Volk oil +X-77			60	60

Literature Cited

1. Bray, W. L. 1910. The mistletoe pest in the southwest. *U.S. Bur. Plant Indust. Bul.* 166.
2. Gill, L. S. and F. G. Hawksworth. 1961. The mistletoes. *U.S. Dept. Agr. Tech. Bul.* 1242.
3. Graser, H. I. 1952. A progress report on mistletoe control in walnuts. *West. Fruit Grower* 6 (2):23-24.
4. ———. 1954. Methods for control of mistletoe. Spot spraying in winter proves effective. *Diamond Walnut News* 36:10.
5. Greenham, C. G. and A G. Brown. 1957. The control of mistletoe by trunk injection. *J. Aust. Inst. Agr. Sci.* 23:308-318.
6. ———, ———, and O. A. Leonard. 196.5 The amino acids of some mistletoes and their hosts. *Amer. J. Botany* 52:41-47.
7. Hull, R. J. and O. A. Leonard. 1964. Physiological aspects of parasitism in mistletoes (*Arceuthobium* and *Phoradendron*). I. The carbohydrate nutrition of mistletoe. *Plant Physiol.* 39:996-1007.
8. ——— and ———. 1964. Physiological aspects of parasitism in mistletoe (*Arceuthobium* and *Phoradendron*). II. The photosynthetic capacity of mistletoe. *Plant Physiol.* 39:1008-1017.
9. Leonard, O. A. and R. J. Hull. 1965. Translocation relationships in and between mistletoes and their host. *Hilgardia* 37 (4):115-153.
10. York, H. H. 1909. The anatomy and some of the biological aspects of the "American Mistletoe" *Phoradendron flavescens* (Pursh) Nutt. *Univ. Texas Bul.* 120.

The Chloroform Test as a Measure of Fermentation in Chinese Tea[1]

J. E. Bellizio and J. Soule

University of Florida, Gainesville[2]

Abstract The chloroform test is a good measure of fermentation, a vital step in the manufacture of black tea. Time of harvest, temperature and duration of exposure to chloroform were variables on two-leaf-and-a-bud samples to assist in selection of Chinese tea clones grown under Florida conditions. Change in color from green to deep golden brown to brown, indicative of good fermentation, took place faster and more uniformly among samples plucked in the morning. Best color development occurred at 27° to 30° C and with 150 to 180 minutes exposure to chloroform vapor.

Assam tea (*Camellia sinensis* var. *assamica*), the principal from in Ceylon, India, and other major tea producing countries, is not adapted to peninsular Florida because of its tenderness to cold. Chinese tea (*C. sinensis* var. *bohea*) has been grown as an ornamental in parts of the southeastern United States for over 100 years; however, lack of labor for harvesting has prevented tea from becoming a commercial crop there (2). With the development of plucking machines, notably in Russia, it is possible that tea could now be grown economically in the United States.

Fermentation is a vital step in black tea manufacture. The fermentation rate must be fast and uniform in commercial tea clones. The chloroform test, described by Sanderson (3) in Ceylon, enables early selection of clones for fermentation rate. Also Katsuo (3) has found good correlation between tea quality and the chloroform test in Japan.

In 1964, the Department of Fruit Crops at the University of Florida established cuttings from about 30 Chinese tea seedlings outstanding for large leaf size and vigorous growth. Cuttings require three to five years to reach a size when regular plucking and processing into black tea may be done. Processing of samples of less than about 1 kg. of green leaf is difficult, but certain characteristics, such as fermentation rate and uniformity of fermentation among groups of clones, can be evaluated with younger plants by the chloroform test. The purpose of the work reported here was to measure the influence of certain sampling and test variables on the chloroform test for Florida-grown tea.

Triplicate samples of tender tips (two partially grown leaves and a bud) from two-year-old Chinese tea clones were exposed immediately after plucking to chloroform vapor in tightly stoppered test tubes. Each tube contained one tip with 0.1 ml. chloroform absorbed on a cotton plug. Temperature was 27° to 30° C, except where temperature was a variable. Leaf color was compared with a standard chart (Table 1) after 90, 120, 150, and 180 minutes exposure. Data were recorded as the average of triplicate samples.

Minimal time for a change in color was 90 minutes. Color development virtually ceased after 180 minutes. This exposure period was considerably longer than reported for Assam tea in Ceylon (3). Sanderson (3) warned, however, that the exposure period would vary from location to location

Table 1. Color rating chart showing the relationship between the color developed in the chloroform test and the fermentation index of tea*

Rating	Color	Fermentation Index
0	Green	Very Bad
1	Green, Vein Golden	Bad
2	Greenish Golden	Poor
3	Golden	Good
4	Golden Brown	Very Good
5	Brown	Excellent

*Adapted from Sanderson (3)

[1] Received for publication *October 3, 1966.* Florida Agricultural Experiment Stations Journal Series No. 2460.

[2] Student Assistant and Associate Horticulturist, Department of Fruit Crops.

according to prevailing temperatures in the plantings.

Color ratings among samples of six clones plucked between 7:00 and 9:00 a.m. ranged from 0.0 to 3.0 after 90 minutes and 3.0 to 4.5 after 180 minutes exposure to chloroform vapor. Among samples plucked between 2:00 and 4:00 p.m., they varied from 0.0 to 2.3 after 90 minutes and 1.0 to 3.3 after 180 minutes. Clones GSM 19, GSM 27, and GSM 30 rated "very good" to "excellent" on the fermentation index (Table 1) after 180 minutes exposure with samples taken in the morning but merely "good" with samples taken in the afternoon. Clones GSM 20, GSM 24, and GSM 31 rated "good" and "bad", respectively. These tests indicated that there were two distinct groups among the six clones with respect to both rate and uniformity of fermentation.

Color changes among samples of GSM 27 held at 21°, 24°, 27°, 30°, and 33° C were similar during the first 120 minutes of exposure. After 90 minutes, all ranged from 3.0 to 3.5 and after 120 minutes, from 3.5 to 4.0. Final color ratings after 180 minutes were 3.5 for the 21° C sample, 4.0 for the 33° C, 4.3 for the 24° C, and 4.5 for the 27° and 30° C. The results verified the conclusion reached in preliminary tests that 27° to 30° C would give the most rapid color change under ordinary conditions.

Samples of GSM 27 were plucked on the mornings of October 9, 15, and 22, 1965, at random so that two variables, time and different plants, were included (inadvertently) in the experiment. Nevertheless, the color ratings were remarkably consistent, being 3.0 to 3.5 after 90 minutes and 4.3 to 4.5 after 180 minutes.

Taken together, these experiments show that chloroform tests when used with samples plucked in the morning and carried out at 27° to 30° C provide a logical basis for selecting groups of young Chinese tea clones under Florida conditions. The three clones which rated highest with the chloroform test, GSM 19, GSM 27, and GSM 30, were initially chosen as the best of the entire 30, with regard to leaf size and plant vigor. These characteristics, while important, are not necessarily reflected in a rapid fermentation rate. Whether tea quality from these plants is acceptable and well correlated with concurrent chloroform tests remains to be seen.

Literature Cited

1. Katsuo, K. 1965. Simple methods of judging the quality of black tea for individual selection work in tea breeding. Part 1. Relationships between the chloroform test, the tannin content and the quality of black tea. Part 2. Relationships between fermentation ability using the Raikai manufacturing process and the quality of black tea. *Study of Tea, 1965, No. 31*, pp. 1-5, bibl. 16; 6-9, bibl. 3. (Hort. Abstr. 36(2):3812.) (Original not seen.)
2. Mitchell, G. F. 1912. The cultivation and manufacture of tea in the United States. *U. S. Dept. Agr. Bur. Plant Indus. Bul. 234*:1-40.
3. Sanderson, G. W. 1963. The chloroform test — a study of its suitability as a means of rapidly evaluating fermenting properties of clones. *Tea Quart.*, Ceylon 34:193-196.

Influence of N[6]-Benzyladenine on the Postharvest Rate of Respiration of Strawberries[1]

M. M. Dayawon and V. G. Shutak

Rhode Island Agricultural Experiment Station, Kingston

Preharvest spray and postharvest dip treatments of N[6]-benzyladenine (N[6]-BA) have been found effective in prolonging storage life of green leafy vegetables (4). It has been suggested that this effect can be explained on the basis of respiration inhibition (1). Dedolph *et al* (2) observed significant reductions of CO_2 evolution and oxygen uptake with N[6]-BA treated broccoli at 21° and 30°C. Freshly harvested asparagus spears treated with N[6]-BA and then held in the dark for 136 hours also showed a lower respiration rate as measured by CO_2 evolution (1). This compound has also been shown to delay visual manifestations of senescence which occur during storage and was effective in maintaining the green color and appearance of several kinds of vegetables (4). In fruits, Smock *et al* (3) found that dip treatment or spraying of N[6]-BA depressed the rate of respiration of apples during the post climacteric phase but accelerated respiration in the preclimacteric phase.

This report presents preliminary data on the effect of this chemical on the rate of respiration of strawberry fruits.

A plot of strawberries (var. Geneva) which consisted of five bearing plants was sprayed with 150 ppm of N[6]-BA. Renex 20 was used as a wetting agent. A similar plot was left unsprayed. Three days after spraying, all mature berrie from both plots were harvested.

Duplicate samples of berries selected for uniformity of size and degree of ripeness were obtained from the treated and non-treated plots were weighed and placed in respiration chambers approximately four hours after harvest. Respiration measurements were initiated after the berries had been in the respiration chamber for two hours and were taken every two hours until 13 measurements had been made. A model 315 Beckman infrared analyzer was used to measure respiration. The rate of respiration was expressed in terms of milliliters of CO_2 evolved per kilogram of fresh berries per hour.

Results of the respiration measurements are presented in Figure 1. These data are the average of duplicate samples of treated and non-treated berries. The rate of CO_2 evolution was markedly depressed for berries treated with N[6]-BA. This difference in the rate of respiration persisted throughout the duration of the experiment.

Although no difference was observed in the appearance of the treated and non-treated berries at the conclusion of the experiment, there are indications that N[6]-BA may prolong the shelf-life of strawberries. These results suggest that further evaluations of N[6]-BA on the keeping quality of strawberries may be desirable.

Literature Cited

1. Dedolph, R. R., S. H. Wittwer, and V. Tuli. 1961. Senescence, inhibition, and respiration. *Sci* 134: 1075.
2. Dedolph, R. R., S. H. Wittwer, V. Tuli and D. Gilbart. 1962. The effect of N[6]-benzyladenine on the respiration and storage behavior of broccoli. *Plant Physiol.* 37: 509-512.
3. Smock, R. M., D. Martin, and C.A.S. Padfield. 1962. Effect of N[6]-benzyladenine on the respiration and keeping quality of apples. *Proc. Amer. Soc. Hort. Sci.* 81: 51-56.
4. Zink, F. W. 1961. N[6]-benzyladenine, a senescience inhibitor for green vegetables. *Jour. Agr. and Food Chem.* 9: 304-307.

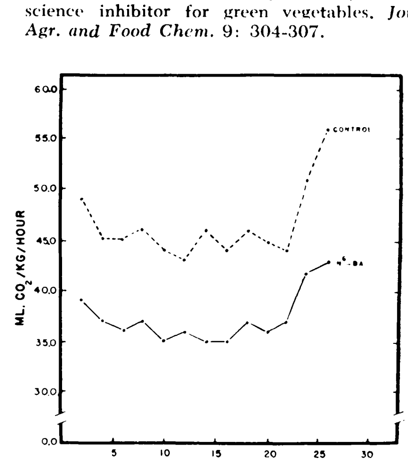

Fig. 1. Post-harvest respiration of Geneva strawberries sprayed with 150 ppm of N[6]-benzyladenine 3 days before harvest.

[1] This study was part of Northeastern Regional Research Project NEM 33 "Chemical and Non-chemical Measures for the Protection of Perishable Food Commodities in Marketing Channels" and was supported (in part) by Regional Research Funds.