

INVESTIGATIONS ON THE EFFECT OF SOME FOLIAR FUNGICIDAL SPRAYS ON CERTAIN PROPERTIES OF MADE TEA

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There has been speculation in the past about the possibility of copper fungicidal sprays having adverse effects on the properties of made tea. This paper describes the results of manufacturing trials on tea sprayed with copper and nickel fungicides, as well as on unsprayed tea. The manufacturing trials commenced one year after the spraying treatments were introduced. The results show that there is an indication that copper-sprayed teas have not been devalued despite duller infusions as compared to tea sprayed with nickel chloride or tea left unsprayed; but that quality, colour, strength and valuation remained unaffected by either of the fungicide sprays.

Introduction

Biochemical investigations (Norris 1944), have revealed that traces of copper present in the tea leaf could have an effect on the chemical reactions taking place during the manufacture of black tea. Some of this copper is associated with an enzyme which controls the process of fermentation. Tea plants with low copper contents in their flush have been reported to be poor fermenters (Eden 1958); and the regular spraying of such bushes with copper compounds is said to improve fermentation. The flush from an extremely poor fermenting clone, TRI 9, was reported to contain only about one fourth the copper present in average samples of tea flush collected from plants derived from seed (Norris 1944; Ramaswamy 1960). Recent laboratory investigations (Wickremasinghe 1964) have shown that copper can act as a catalyst to promote the atmospheric oxidation of the tea catechins.

The oxidation of the polyphenolic substances present in tea flush is initiated by the rolling operation. The oxidised polyphenols then undergo a series of chemical reactions, one of which concerns the decomposition of the green coloured chlorophylls, to the brown coloured compounds the phaeophytins, which in turn are responsible for bright, "coppery" infusions (Norris 1944; Ramaswamy 1958). It is, however, possible for the chlorophylls to remain green and undergo no changes during the fermenting process. The earlier theory for such a mechanism was based on the assumption that the magnesium present in the chlorophyll complex was replaced by copper thereby adding to its stability (Norris 1944; Lamb 1945). It now seems that the more likely explanation for such a process would be that the enzyme chlorophyllase was inactivated by copper. The activity of this enzyme is also inhibited by other heavy metals. Chlorophyllase is responsible for the breakdown of the chlorophylls *in vivo* to the brown coloured phaeophytins (Holden 1961). Keegel (1958) has reported that the colour of an infusion was not a reliable guide to the liquoring properties of a tea; it was possible for a tea to have simultaneously, an attractive liquor as well as a greenish infusion.

In view of the available evidence that traces of copper could regulate the fermentation process, as well as affect the colour of the infused leaf, it was decided to investigate the effect of regular foliar sprays of copper fungicides used for the control of Blister blight (*Exobasidium vexans* Masec) on the characteristics of made tea.

Experimental Work

The following three treatments were applied to seedling tea in the second year of its pruning cycle at St Coombs estate (elevation 4500 ft):

- 1 'Perenox' (a cuprous oxide formulation containing 50% copper) was applied at the rate of 4 oz in 15 gallons of water per acre,
- 2 Nickel chloride hexahydrate (containing 25% nickel) was applied at the rate of 4 oz in 15 gallons of water per acre,
- 3 Unsprayed controls.

The details of the experimental layout and environmental conditions have already been described (de Silva 1965). All plots were unsprayed from 1st January to 1st May 1964. Thereafter treatments 1 and 2 were applied every 8 to 10 days until the end of 1964. Nickel chloride was used as a separate check in addition to the unsprayed treatment. The leaf from each of the treatments was manufactured by the miniature-scale manufacturing technique with 2 lb samples of withered leaf for each treatment. The duration of wither was 14-17 hours and an outturn of 45% made tea to withered leaf was aimed at. Four rolls, each of 30 min duration were given with an 8 on 2 off method of pressure application; the big bulk outturn was 10%. This experiment was replicated 12 times and each was tasted and reported upon by a panel of four tasters in Colombo.

Results

The mean evaluations of the twelve replicates are given in Table 1. Marks for each of the liquoring characteristics have been awarded by the tea tasters on a scale ranging from 0 to a maximum of 10. The valuations are given in cents per pound.

TABLE 1—Means of tasters valuations from twelve replicated experiments on the effect of copper and nickel fungicides on the properties of made tea

CHARACTERISTIC	TREATMENTS			Significant difference at P=0.05
	Control unsprayed for 1 year at commencement of trial	Sprayed with 1 oz metallic Nickel/acre/round	Sprayed with 2 oz metallic Copper/acre/round	
Brightness of infused leaf	4.98	4.60	4.40*	0.49
Colour	4.55	4.26	4.72	not significant
Strength	5.02	5.09	5.19	„
Quality	5.11	5.36	5.62	„
Valuation (cents per pound)	293.1	299.0	300.8	„

* The infusions from copper sprayed tea are significantly inferior to those from unsprayed tea ($P < 0.07$)

From this table it is seen that the made tea characteristics of colour, strength, quality and valuations have not been significantly affected by the foliar fungicidal sprays at the stated levels of application. There is an indication at the 7% level of probability, that the cuprous oxide sprays have resulted in duller infusions when compared with the unsprayed control.

Discussion

There are indications that the copper sprays have resulted in somewhat duller infusions, as compared with teas manufactured from plots left unsprayed for one year before the commencement of the manufacturing trials.

The other characteristics including the valuations have not been significantly affected and, therefore, there is no evidence to show that the copper sprays at the recommended level of 4 oz per acre per round affected quality or valuation. Nickel spraying does not seem to have any effect on the properties of made tea. Ramaswamy (1960) states that copper is present in trace quantities in made tea, and it seems possible that a reserve of copper may have been present in the bush and/or in the soil of the unsprayed plots during the trials. This experiment is therefore being continued over a whole pruning cycle, in order to investigate long term effects.

References

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