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Nitrogen and Potassium Fertilization as Related to the Yield of Peel Oil from 'Pineapple' Oranges[1]

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Abstract. **An N rate associated with reduced fruit production substantially reduced the quantity of peel oil on a per metric ton (MT) of fruit basis and the yield of oil on a per hectare basis of 'Pineapple' orange (*Citrus sinensis* (L.) Osbeck) K had no significant effect on the peel oil content on a per ha basis, but did increase fruit production (MT/ha) and reduced the peel of oil content.**

The peel oil content of California oranges (1) has been shown to be directly correlated with the surface area of the fruit. Rootstock (2) also influenced the amount and composition of the oil components in 'Valencia' oranges. In Florida (3, 5, 6) it has been demonstrated that budwood selections can increase the oil content of the fruit, and that rootstock affects the chemical composition of the oil, particularly aldehyde content. Fertilization and irrigation (6, 7, 8, 9) of Florida lemons was shown to increase both fruit yield and peel oil content. Increased nitrogen applications increased both fruit and oil yield; whereas, increased potassium applications suppressed oil yield but increased fruit yield. Irrigation applications also improved fruit and oil yields. The purpose of this paper is to report the peel oil content of 'Pineapple' oranges as related to N and K fertilization.

Materials and Methods

Peel oil content (4) was determined as follows: 2 discs (2 cm diam) were cut from each of 16 fruit at the equatorial section of the fruit. The fruit was weighed and the longitudinal and equatorial diameters measured. Kilograms of peel oil per MT of fruit were calculated by determining the volume of oil per unit surface area of fruit, extrapolating for the equivalent surface area and volume of oil in a MT of fruit, and finally converting to weight by using the density of the oil. The 16 fruit samples were collected from 4 trees by picking 4 fruit midway from the top and the bottom of each tree at the 4 cardinal points of the compass.

Fertilizer studies (10) were conducted at 4 rates each of ammonium nitrate (N) and alternate applications of potassium chloride and potassium sulfate (K). The peel oil content was determined on fruit from 4 tree plots with 4 replications in a 4 × 4 N and K factorial design. A factorial analysis was used to evaluate data and the effects of N and K on peel oil and fruit yield, and N–K interactions were tested for significance. The total number of samples was 64. Duncan's multiple range values were obtained from the data.

Results and Discussion

Three years' results of a long-term fertilization study on 'Pineapple' oranges involving 4 levels of N and K are shown in Table 1. Factorial analyses of the averaged 3 years' data showed no significant N–K interaction for MT fruit/ha or kg oil/ha, but showed a significant N–K interaction for kg peel oil/MT

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Table 1. Effects of N and K fertilization on the yield of 'Pineapple' orange peel oil.

Fertilizer level (kg/ha • yr)	Fruit production (MT/ha)			Peel oil kg/MT fruit			Peel oil kg/ha		
	1974	1975	1976	1974	1975	1976	1974	1975	1976
N_1 (79)	32.7a[y]	25.5a	27.2a	8.0a	10.3a	8.3a	260a	265a	225a
N_2 (157)	42.8b	38.6b	46.7b	9.3b	11.4b	9.7b	396b	438b	452b
N_3 (236)	41.9b	40.7b	46.6b	9.4b	11.4b	10.3c	396b	461b	477b
N_4 (314)	41.6b	38.7b	43.7b	9.3b	11.9b	9.9bc	388b	461b	436b
Sig.[z]	**	**	**	**	**	**	**	**	**
K_1 (66)	36.2a	32.4a	37.0a	9.4b	11.7b	10.2b	345a	382a	383a
K_2 (130)	41.1b	36.2b	43.5b	9.1b	11.2a	9.5a	373a	408a	423a
K_3 (196)	40.7b	38.3b	41.4b	9.0b	11.0a	9.4a	367a	423a	392a
K_4 (261)	40.9b	36.6b	42.5b	8.5a	11.1a	9.1a	349a	410a	386a
Sig.[z]	**	*	N.S.	**	**	**	N.S.	N.S.	N.S.

[z]N.S. – Not significant. *Significant at 5% level. **Significant at 1% level.

[y]Mean separation within columns within N or K level by Duncan's multiple range level, 5% level.

fruit. This can be interpreted as meaning that the amount of N affecting the quantity of oil in individual fruit will be influenced by the amount of K and will be different for each level of K. Increasing K decreases the oil/MT fruit, while increasing N increases the oil/MT fruit. When converted to a per ha basis, the preferred method to evaluate cultural practices, the annual N rate of 79 kg/ha produced less fruit and less peel oil per MT of fruit than rates of 157 kg/ha or higher (Table 1). No significant interactions between N–K were found for MT fruit/ha, kg peel oil/MT fruit or kg peel oil/ha on a yearly basis.

Potassium had no significant effect on peel oil content (kg/ha) (Table 1). However, low applications of K caused higher oil content kg/MT fruit but lower fruit yields. Higher applications of K gave lower oil contents and increased fruit yields. These 2 factors tended to equalize the overall yield of peel oil (kg/ha). The data indicate that 157 kg of K/ha • yr gives the best yield of fruit (MT/ha) and peel oil (kg/ha). When N and K are considered jointly for yields of both fruit and peel oil, these data indicate the N_3K_2 rate to be optimum. Economically, the N_2K_2 rate would probably be the preferred fertilizer application, since the N_3 and N_4 rates do not substantially increase the yield of oil and fruit over that of the N_2 rate.

Literature Cited

1. Bartholomew, E. T. and W. B. Sinclair. 1946. Factors influencing the volatile oil content of the peel of immature and mature oranges. *Plant Physiol.* 21:319-331.
2. Bitters, W. P. and R. W. Scora. 1970. The influence of citrus rootstocks upon the volatile rind oil content of 'Valencia' oranges. *Bot. Gaz.* 131:105-109.
3. Drescher, R. W., R. A. Dennison, and J. W. Kesterson. 1971. Yield of peel oil as related to budwood and rootstocks. *Proc. Fla. State Hort. Soc.* 84:190-193.
4. Hendrickson, R., J. W. Kesterson, and S. V. Ting. 1969. Peel oil content of 'Valencia' oranges. *Proc. Fla. State Hort. Soc.* 82:192-196.
5. _____, _____, and M. Cohen. 1970. The effect of rootstock and budwood selections on the peel oil content of 'Valencia' oranges. *Proc. Fla. State Hort. Soc.* 83:259-262.
6. Kesterson, J. W., R. J. Braddock, and R. C. J. Koo. 1974. The effect of budwood, rootstock, irrigation, and fertilization on the yield of Florida lemon oil. *Proc. Fla. State Hort. Soc.* 87:6-9.
7. _____ and _____. 1975. Effects du Cultivar, du Portegraffe, de l'Irrigation et de la Fertilisation sur le Rendement et la Qualite des Huiles Essentielles d'Agrumes. *Fruits* 30:103-107.
8. Koo, R. C. J., T. W. Young, R. L. Reese, and J. W. Kesterson. 1973. Responses of 'Bearss' lemon to nitrogen, potassium and irrigation applications. *Proc. Fla. State Hort. Soc.* 86:9-12.
9. _____, _____, _____, and _____. 1974. Effects of nitrogen, potassium and irrigation on yield and quality of lemon. *J. Amer. Soc. Hort. Sci.* 99:289-291.
10. Reese, R. L. and R. C. J. Koo. 1975. N and K fertilization effects on leaf analysis, tree size, and yield of three major Florida orange cultivars. *J. Amer. Soc. Hort. Sci.* 100:195-198.