Modification of Peanut Oil Fatty Acid Composition by Foliar Applications of 2′,2′-Dimethylsuccinohydrazide (Kylar)

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In a 3-year study, the growth regulator 2′,2′-dimethylsuccinohydrazide (Kylar), applied alone or in combination with a benomyl fungicide, reduced levels of linoleic acid (18:2) in peanut oil. Fungicide alone significantly increased levels of 18:2. The greatest difference in 18:2 was between plots treated with fungicide alone and Kylar alone (*e.g.*, 35.2 *vs.* 32.9%); this difference was highly significant each year. When applied to plots treated with fungicide, Kylar significantly reduced 18:2 to levels that were not significantly different from untreated controls. Kylar alone also reduced 18:2 as compared with untreated controls but the reduction was significant in only 1 year. Stearic acid was reduced by fungicide alone but was not changed by application of Kylar to plots treated with fungicide. Palmitic, oleic, and eicosenoic acids showed small but occasionally significant response to Kylar.

2′,2′-Dimethylsuccinohydrazide, a plant growth regulator marketed under the trade name of Kylar, is currently applied to several plant species to modify growth, fruiting, and ripening processes. The compound is readily translocated within plants (Undurranga and Ryugo, 1970), and its mode of action is believed to be due, at least in part, to interference with normal auxin formation and subsequent reduction in cell elongation (Williams and Stahly, 1970). In the peanut, foliar application of Kylar reduces pod and peg length (Brown *et al.*, 1973) and internode length of stems (Brittain, 1967). Although seed yields are sometimes increased (Brown *et al.*, 1973), the principal contribution of Kylar to peanut culture is in reduction of plant size. Current cultural practices, including control of Cercospora leafspot disease, favor the accumulation of excessive vegetative material which can be a hindrance to harvesting operations. Accordingly, the incorporation of Kylar into peanut cultural practices is receiving considerable attention (Whitty, 1973).

This study was undertaken to determine the effects of Kylar on the fatty acid composition of peanut oil. Oil constitutes approximately 50% of the dry weight of peanut seed and alterations in fatty acid composition might reasonably be expected to affect stability and other quality attributes of peanut products.

MATERIALS AND METHODS

Since in current practices application of Kylar is usually made to peanuts also treated with fungicides, this study included plots treated with fungicide, fungicide + Kylar (1971, 1972), and Kylar alone, as well as untreated control plots. The chemical agents were applied to peanuts planted in randomized blocks with four replications per treatment in 1970 and 1972 and three replications in 1971. Test varieties were grown at Plains, Ga., and included Argentine in 1970 and 1971 and Tifspan in 1972. The fungicide methyl 1-(butylcarbamoyl)-2-benzimidazolecarbamate (Benlate) was applied as indicated by meteorological conditions (Jensen and Boyle, 1966) in 1970 and following a 21-day schedule in 1971 and 1972, at a rate of 0.37 kg/ha per application. Kylar was applied at the rate of 1.2 and 0.56 kg/ha at 60 and 90 days after planting, respectively.

Samples were obtained with official Federal–State Inspection Service grading screens from peanuts that were harvested, dried, and shelled according to accepted practices. The analytical procedures employed in determining fatty acid composition were described previously (Worthington *et al.*, 1972).

Each field plot was analyzed in duplicate and an analysis of variance was performed as described by Anderson and Bancroft (1952) for repeated subsampling; treatment effects were evaluated with the variance of field replications. The means of those treatments found to be significantly different at the 5% level or higher were submitted to the Duncan's multiple range test (see Table I).

RESULTS AND DISCUSSION

Kylar reduced levels of linoleic acid (18:2) when applied either alone or to plants also treated with fungicide. Fungicide alone significantly increased levels of 18:2 and the greatest difference in levels of this fatty acid occurred between samples from plots treated with fungicide alone and those treated with Kylar alone. This difference was highly significant each year of the study. When applied to plots also treated with fungicide, Kylar significantly reduced linoleic acid to levels that were not statistically different from levels found in samples from untreated control plots. The effect of foliar fungicides on peanut oil fatty acid composition has been reported earlier (Worthington and Smith, 1973). Application of Kylar alone reduced levels of linoleic acid as compared with values from untreated control samples but this reduction was statistically significant only in 1972. The most pronounced alterations in fatty acid composition were observed in 1972 when iodine value, as computed from fatty acid composition, showed a difference of 2.84 between samples from plots treated with Kylar and with fungicide. The fatty acid composition of peanut oil is determined by variety and is also influenced by yearly variations in environmental factors. The increased response to Kylar observed in 1972 as compared with previous years may therefore have been due to either variety x treatment, year x treatment, or other interactions. We consider the year x treatment interaction to be the more tenable explanation since the effect of Kylar is more pronounced when application is made during periods of moisture stress. The manufacturer recommends that it not be applied under these conditions. Moisture stress was considerably greater during the period of fruit development in 1972 than in either 1970 or 1971.

Alterations in the levels of other fatty acids were less consistent. Oleic acid was increased by Kylar each year but the increase was significant only in 1970 and 1972. Levels of stearic acid were reduced by fungicide alone but were not changed by application of Kylar to plots also

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Table I. Influence of Foliar Applications of a Growth Regulator and a Fungicide on the Fatty Acid Composition and Calculated Iodine Values of Peanut Oil

Year, variety, and treatment	Fatty acid composition, %								Iodine value[a]
	16:0	18:0	18:1	18:2	20:0	20:1	22:0	24:0	
1970, Argentine									
Benlate	12.46	3.64b[b]	42.30b	34.69a	1.45b	0.80	3.37	1.28	101.47
Control	12.45	4.09a	42.28b	34.04b	1.59a	0.72	3.48	1.35	100.21
Kylar	12.72	4.06a	42.78a	33.56b	1.68a	0.76	3.25	1.18	99.82
Significance	NS[c]	*	*	**	*	NS	NS	NS	
1971, Argentine									
Benlate	11.48	4.31c	43.19	33.69a	1.94	0.84	3.32	1.23	100.49
Benlate + Kylar	11.68	4.45c	43.69	33.02b	1.87	0.81	3.32	1.17	99.71
Control	11.60	5.26a	43.22	32.64bc	2.05	0.78	3.28	1.16	98.57
Kylar	11.53	5.15b	43.52	32.43c	2.04	0.79	3.41	1.14	98.47
Significance	NS	**	NS	**	NS	NS	NS	NS	
1972, Tifspan									
Benlate	12.68b	3.30c	41.89c	35.15a	1.61c	0.93b	3.23	1.24a	102.04
Benlate + Kylar	12.70b	3.26c	42.62b	34.28b	1.63bc	0.99a	3.31	1.22a	101.17
Control	12.79b	3.62b	42.52b	34.11b	1.66ab	0.89b	3.22	1.20ab	100.67
Kylar	13.03a	3.77a	43.22a	32.93c	1.67a	0.91b	3.32	1.16b	99.20
Significance	*	**	**	**	*	**	NS	*	

[a] Iodine values were calculated from average fatty acid values and were not included in the analysis of variance. [b] Values followed by the same letter are not significantly different at the 5% level. [c] Single and double asterisks indicate squares significant at the 5 and 1% levels, respectively; NS, not significant.

treated with fungicide. As compared with samples from untreated control plots, samples from plots treated with Kylar alone were significantly lower in stearic acid in 1971 and higher in 1972. Palmitic (16:0), oleic (18:1), and eicosenoic (20:1) acid showed generally small but occasionally significant response to Kylar in 1 or more years of the study.

Visual inspection of samples harvested in 1972 revealed a greater degree of interior pericarp pigmentation in samples treated with Kylar. Such pigmentation is considered to be a reliable indicator of seed maturity (Schenk, 1961), and when taken together with the decrease in level of linoleic acid, suggests that Kylar accelerates the maturation process in peanuts. This hypothesis is consonant with the maturity–fatty acid relationships reported earlier by Worthington (1969) and Young *et al.* (1972).

That factors other than simple maturity levels are responsible for the alterations in fatty acid content is indicated by the negative correlation between palmitic and linoleic acid observed in 2 years of the study and found by regression analysis to be significant in 1972. A strong positive correlation (r = 0.94) exists between these two fatty acids among genotypes (Worthington and Hammons, 1971). Published data also show a positive correlation related to maturity changes in both Virginia (Worthington, 1969) and Spanish (Young *et al.*, 1972) type peanuts. The observed shift in correlation between 16:0 and 18:2 suggests that treatment effects are only partially related to different ratios of mature and immature seed within samples from the various treatments and that these changes may also be due in part to mild inhibition of the sequential chain elongation and desaturation reactions leading from 16:0 to 18:2 in the developing seed.

The alterations in fatty acid patterns observed in this study, though statistically significant, were small as compared with differences normally occurring among genotypes (Worthington and Hammons, 1971; Worthington *et al.*, 1972).

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