

## Effects of Succinic Acid 2,2-Dimethylhydrazide on Yield and Other Characteristics of Peanut Cultivars<sup>1</sup>

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### ABSTRACT

Succinic acid 2,2-dimethylhydrazide (SADH) was applied at 0.95 kg/ha 60 days after planting to seven peanut (*Arachis hypogaea* L.) cultivars in 1970 and eight cultivars in 1971 and 1972. Pod yield of all cultivars were increased by SADH in 1970 by an average of 20%. Yields of Spanish type cultivars were increased in 1971 but not in 1972, while yields of runner and Virginia cultivars were not affected in 1971 nor 1972. There was a trend for increases in the number of pods per plant in Spanish cultivars in all three years and in runner and Virginia types in 1970. Weight per 100 pods was reduced in the Spanish cultivars only in 1972. Main stem lengths were reduced by SADH treatment by an average of 32% in 1970 and 27% in 1971.

**Additional key words:** Kylar, Alar, B-nine, growth retardant, groundnuts.

Succinic acid 2,2-dimethylhydrazide (SADH) has been tested on a large number of species and found to have a growth retarding effect on vegetative plant parts (Fisher and Looney, 1967; Stahly and Williams, 1967; Unrath *et al.*, 1969; Younis and Elnur, 1970). It has been shown by Brittain (1967) and Brown *et al.*, (1973) to retard vegetative growth in peanuts (*Arachis hypogaea* L.). Brown *et al.* (1973) also reported a reduction in length of pods and pegs by SADH in the peanut cultivar, 'Starr'. The most consistent effect of SADH was a reduction in stem length. Yield was increased in one year out of three by SADH in the Starr cultivar.

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The research reported here was initiated to investigate the effect of SADH on yield and associated characteristics of peanuts. Several cultivars were included to determine if there were differential effects among cultivars.

### Materials and Methods

The following cultivars were planted in 1971 and 1972 - 'Argentine', 'Tifspan', 'Spancross', 'Starr', 'Early Runner', 'Florunner', 'Florigiant' and 'Virginia Bunch 67'. The first four cultivars are Spanish (*A. hypogaea* ssp. *fastigiata* var. *vulgaris*) types with upright growth and small seeds. The latter four cultivars are of the Virginia botanical group (*A. hypogaea* ssp. *hypogaea* var. *hypogaea*) with Early Runner, Florunner and Virginia Bunch 67 in the runner market category, and Florigiant in the Virginia market class. In 1970 the same cultivars were planted with the exception of Starr.

The experiments were conducted at Plains, Georgia on a Greenville silt loam soil which was prepared with conventional tillage methods. A 4-5.28-9.96 (N-P-K) fertilizer was applied at 834 kg/ha prior to soil preparation. Two pairs of rows were planted on 1.62 m wide beds, with 41 cm between pairs of rows and 25 cm between rows of each pair. All cultivars were planted at a rate of 134 kg of seed/ha. Weeds were controlled by incorporating 1.09 l. of Vernam (5-propyl dipropylthiocarbamate) and 2.3 l. of Balan (N-butyl-N-ethyl-a,a,a-trifluoro-2,6-dinitro-p-toluidine) per ha. prior to planting and by spraying on Dinitro (4,6-dinitro-o sec-butyl phenol) or Dyanap (mixture of dinitro and N-1-Naphthyl phthalamate) just before emergence. Control of *Cercospora* leaf spot was obtained by repeated applications of copper-sulfur dust (90% cuprous oxide - 10% elemental sulfur) in 1970 and Benlate (Methyl 1-(butylcarbamoyl)-2-benzimidazole carbamate) fungicide in 1971 and 1972.

The experiments were irrigated in an attempt to supply at least 2.5 cm of water per week from either rainfall or supplemental irrigation. This was not attained in every case, however, yields were high and water stress was not considered to have reduced yields in any year. Satisfactory stands were obtained for all varieties in each year, except for Spancross in 1971.

SADH was applied at approximately 60 days after planting at a rate of 9.95 kg/ha. A wettable powder formulation of SADH (85% active ingredient) was mixed with water and applied at a rate of 94 liters of mixture per ha. A small plot sprayer mounted on bicycle wheels was used for SADH applications. No rain occurred within 6 hours following application in any of the three years. Peanuts were in the pegging stage of growth and many small pods were beginning to develop when SADH was applied. At this stage the dry weight was 10 to 15 g per plant. The canopy was well developed on the bed, but plants were not overlapping in the space between beds for any of the cultivars.

The experimental design was a randomized complete block with split plots. Peanut cultivars were assigned to whole plots and SADH treatments to sub-plots. In 1970 and 1971 sub-plots were 1 bed (1.62 m) wide x 6.1 m long, with border beds of the Starr cultivar alternating with experimental beds. In 1972 sub-plots were 2 beds wide with border beds between sub-plots. There were three replications of SADH treatments on each cultivar in 1970, six in 1971 and five in 1972. In 1971 three replications were sprayed with the wettable powder formulation and three with a liquid formulation. In 1971 and 1972 Spanish cultivars were planted in separate experiments from the other types and results were analyzed separately.

Peanuts were harvested by uprooting plants with conventional blades, shaking by hand to remove soil and threshing plants from individual sub-plots with a commercial peanut combine. When necessary, harvested samples were artificially dried. In clear weather they were field dried.

At about 1 month after spraying with SADH in 1970 and 1971, plant height estimates were made by measuring the length of the main stem on 3 plants selected at random per plot. At harvest in 1971 and 1972 plant samples were collected and separated into component parts to estimate pod number, pod weight, and stem and leaf weight per plant. Five plants per plot were taken in 1971 and 10 plants per plot in 1972. Weight per 100 pods was calculated from pod data from these samples in 1971 and 1972 and from harvested samples in 1970. In 1971 pod lengths were measured on 10 pods at random taken from plants sampled at harvest.

Table 1. Experimental details for SADH experiments, 1970-1972.

Item	Year		
	1970	1971	1972
Planting date	4-28	5-15	5-2
Date SADH applied	6-26	7-8	6-29
Date of Harvest			
Spanish Type	8-26	9-8	9-18
Runner and Bunch Types	9-2	9-21	10-3
Rain plus irrigation from planting to harvest, mm	940	703	442

Dates pertinent to the culture and harvest of the peanuts and rainfall plus irrigation amounts are given in Table 1.

## Results

### Pod yields.

Yields were increased by an average of 20% in 1970 by application of SADH (Table 2). The increases were similar for cultivars of Spanish, runner and Virginia market types and were significant for all varieties. In 1971 yields of the Spanish

Table 2. Effect of SADH on Pod Yield (8% moisture) of Eight Peanut Cultivars.

Cultivar	SADH Applied	Yields*			
		1970	1971	1972	Mean
	kg/ha	kg/ha			
Argentine	0	3684a	3282a	5172	4046
	0.95	4503b	3488b	5135	4375
Tifspan	0	3980a	3396a	5053	4143
	0.95	4903b	3341a	5264	4503
Spancross	0	4029a	2562 <sup>†</sup> a	5227	3939
	0.95	4819b	2823b	5465	4369
Starr	0	-	3060a	5631	4345
	0.95	-	3569b	5566	4567
Mean - Spanish Types	0	3898a	3075a	5271	4118
	0.95	4742b	3305b	5357	4453
Early Runner	0	3733a	4851a	4915	4500
	0.95	4531b	4988a	4759	4759
Florunner	0	5164a	5089a	6007	5420
	0.95	5934b	4769a	5768	5490
Florigiant	0	4251a	4828a	5089	4723
	0.95	5276b	5636b	5200	5371
Virginia Bunch 67	0	3210a	4609a	3274	3698
	0.95	3663b	4540a	3072	3758
Mean - Runner and Virginia types	0	4089a	4844a	4821	4585
	0.95	4851b	4983a	4700	4844

\* Means followed by different letters are significantly different - 1% level in 1970, 5% level in 1971. There were no significant effects of SADH in 1972.

<sup>†</sup> Poor stand in 1971 with Spancross cultivar.

varieties were increased by an average of 230 kg/ha, while yields of runner and Virginia types were not consistently affected. The SADH X cultivar interaction was significant in the case of the runner and Virginia types with yields of Florigiant only being significantly increased. In 1972 SADH had no effect on yields. The most responsive cultivar over the three year period was Florigiant with an average increase in yield of 13.7%, although yield in 1972 was not significantly increased. Yields of Florunner, on the other hand, were increased only in 1970 and showed a tendency toward a decrease due to SADH in 1971 and 1972.

Yields of the Spanish types were considerably lower in 1971 than in 1970 or 1972, whereas yields of runner and Virginia types were nearly the same all three years, particularly when treated with SADH.

### Pod number and size.

Weight per 100 pods was not consistently affected by SADH (Table 3). A significant decrease of 11.9% was observed for the Spanish type cultivars in 1972. There was no effect of SADH on weight per 100 pods in Spanish cultivars in 1970 and 1971 nor in runner and Virginia cultivars in any year. There was no significant effect of SADH on pod numbers per plant in 1971 and 1972, even though weight per pod was decreased in Spanish varieties in 1972 and yield was not affected. The large variance in pod number per plant may have prevented detection of SADH effects. Pods were

**Table 3. Effect of SADH on Weight per 100 Pods of Eight Peanut Cultivars.**

Cultivar	SADH Applied kg/ha	Wt. per 100 pods		
		1970	1971	1972
Argentine	0	77a	77a	81a
	0.95	75a	71a	75b
Tifspan	0	83a	74a	85a
	0.95	78a	67a	75b
Spancross	0	80a	70a	86a
	0.95	79a	64a	73b
Starr	0	-	65a	84a
	0.95	-	66a	75b
Mean - Spanish types	0	80a	71a	84a
	0.95	77a	67a	74b
Early Runner	0	116a	107a	92a
	0.95	103a	102a	84a
Florunner	0	134a	114a	114a
	0.95	137a	140a	104a
Florigiant	0	206a	150a	179a
	0.95	174a	169a	177a
Virginia Bunch 67	0	125a	109a	102a
	0.95	126a	110a	101a
Mean - Runner and Virginia types	0	145a	120a	122a
	0.95	135a	130a	116a

Means followed by different letters are significantly different - 1% level.

not counted in 1970, but the small differences in weight per 100 pods (Table 3) coupled with the large yield increases caused by SADH indicates increased pod numbers per plant.

#### Stem lengths.

The most consistent effect of SADH on morphology was a reduction in stem lengths. Measurements made in 1970 and 1971 at approximately one month after SADH application show reduc-

**Table 4. Effect of SADH on length of the main stem in peanut cultivars.**

Cultivars	SADH <sup>†</sup> Applied kg/ha	1970		1971	
		Length* cm	Decrease %	Length* cm	Decrease %
Argentine	0	68a	-	61a	-
	0.95	42b	38	45b	26
Tifspan	0	59a	-	56a	-
	0.95	41b	30	40b	29
Spancross	0	67a	-	50a	-
	0.95	42b	37	38b	24
Starr	0	-	-	59a	-
	0.95	-	-	40b	32
Early Runner	0	43a	-	50a	-
	0.95	30b	30	38b	24
Florunner	0	46a	-	52a	-
	0.95	32b	30	39b	25
Florigiant	0	52a	-	53a	-
	0.95	36b	31	40b	24
Virginia Bunch 67	0	68a	-	61a	-
	0.95	49b	28	43b	29

\* Means for each cultivar within each year followed by different letters are significantly different - 1% level.

<sup>†</sup> SADH was applied on 6-26-70 and 7-8-71; stem lengths were measured on 7-27-70 and 8-5-71.

tions of between 25 and 40% compared to controls (Table 4). Plant height differences were not as great at harvest as at three to four weeks after treatment.

#### Vegetative weights.

Weight of plant tops was reduced by SADH at about one month after treatment in 1970, Table 5. In 1972, top weights of the runner and Virginia cultivars were reduced by SADH when sampled at harvest time. Only Florigiant, among the four cultivars sampled at harvest in 1971, had reduced top weights due to SADH treatments. Because of heavy leaf losses, Spanish cultivars were not sampled for top weights at harvest in 1971 and 1972.

**Table 5. Effect of SADH on vegetative weights of peanut cultivars.**

Cultivars	Vegetative weight, g/plant					
	7/27/70		9/16/71		9/27/72	
	SADH	Control	SADH	Control	SADH	Control
Argentine	23.2	31.7	-	-	-	-
Tifspan	20.7	37.5	-	-	-	-
Spancross	26.2	28.0	-	-	-	-
Early Runner	19.5	40.5	43.0	34.2	24.7	26.5
Florunner <sup>†</sup>	-	-	26.4	31.4	26.3	29.2
Florigiant	41.7	48.7	55.8a	72.8b	34.1	41.1
Virginia Bunch 67	40.0	51.5	48.8	48.4	36.5	37.7
Mean*	28.5a	39.7b	43.5a	46.7a	30.4a	33.6b

\* Means within each date followed by the same letter are not significantly different at the 5% level. On 9/16/71 the effect of SADH was not significant overall, but the interaction between cultivars and SADH was significant - 5% level. Florigiant was the only cultivar significantly affected on that date. SADH was applied on 6/26/70, 7/8/71 and 6/29/72.

<sup>†</sup> Samples of Florunner for 1970 were lost.

## Discussion

As in a previous report with the Starr cultivar (Brown *et al.*, 1973) yields of pods were not consistently affected by SADH. The 20% increase in yields in 1970, however, indicates the possibility for yield increases. The yield increases in 1970 were due to an increase in the number of pods per plant, since weight per 100 pods was not affected. Although the number of pods per plant, as counted was not increased significantly due to SADH, a trend in this direction was indicated for the Spanish cultivars in 1971 and 1972. In 1971 pod yields were increased by SADH with no increase in weight per 100 pods, thus indicating an increase in pod number. In 1972 yields were not changed by SADH, but weight per 100 pods was decreased by 11.9% again indicating an increase in pod number.

The most consistent effect of SADH in these experiments was a reduction in plant height. There was an average reduction in main stem length of 32% in 1970 and 27% in 1971 due to SADH, which was applied about 1 month before

measurements were made. In 1970 the reductions in stem length were paralleled by reduced vegetative weights of plants harvested on the date that stem lengths were measured. In 1972 there was a reduction in vegetative weights of runner and Virginia cultivars at harvest due to SADH application. Vegetative weights of runner and Virginia cultivars were not reduced at harvest in 1971 with the exception of Florigiant, in which case SADH reduced vegetative weights by 23%. Thus, in some instances the reductions in plant height caused by SADH resulted in less vegetative weight.

The lack of consistent effects of SADH on pod yields is not explainable at this time. Variations in environment from year to year may play a part in the erratic response. The timing of SADH application with regard to the flowering or fruiting activity may have varied from year to year. Applications have been made at 60 days after planting, when plants are actively pegging but the number of pegs, flowers or other characteristics have not been estimated at the time of application. Such observations may have been helpful in explaining the response.

## Literature Cited

1. Brittain, J. A. 1967. Response of *Arachis hypogaea* L. to succinic acid 1,1-dimethylhydrazide. Ph.D. Dissertation. Virginia Polytechnic Institute, Blacksburg. 81 p. Diss. Abs. 28:3938B.
2. Brown, R. H., W. J. Ethredge and J. W. King. 1973. Influence of succinic acid 2,2-dimethylhydrazide on yield and morphological characteristics of 'Starr' peanuts (*Arachis hypogaea* L.). *Crop Science* 5:507-510.
3. Fisher, D. V. and N. E. Looney. 1967. Growth, fruiting and storage response of five cultivars of bearing apple trees to N-dimethylamino succinamic acid (Alar). *Amer. Soc. Hort. Sci. Proc.* 90:9-19.
4. Stahly, E. A. and M. W. Williams. 1967. Size control of nursery trees with N-dimethylamino succinamic acid. *Amer. Soc. Hort. Sci. Proc.* 91:792-794.
5. Unrath, C. R., A. L. Kenworthy and C. L. Bedford. 1969. The effect of Alar, succinic acid 2,2-dimethylhydrazide, on fruit maturation, quality and vegetative growth of sour cherries (*Prunus cerasus* L. cv. Montmorency). *J. Amer. Soc. Hort. Sci.* 94:387-391.
6. Younis, M. E. and E. E. Elnur. 1970. Modification of vegetative development, flowering and fruiting of broadbean by N-dimethylamino succinamic acid. *Acta Agron.* 19:185-189.