# Effects of Time of Application of Succinic Acid 2,2-Dimethylhydrazide on Yields and Associated Characteristics of Peanuts[1]

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ABSTRACT

Experiments were conducted during 3 years to evaluate the effects of applying succinic acid 2,2-dimethylhydrazide (SADH) at various times during the growing season on yield and other characteristics of peanuts (**Arachis hypogaea** L.). Plants in field plots were treated with 0.95 kg/ha of SADH at 6, 8, 10 or 12 weeks after planting. SADH was applied as a foliar spray to the 'Starr' cultivar in 1970 and 'Tifspan' and 'Florunner' cultivars in 1971 and 1972. In 1970 and 1972 an "as needed" treatment was included to keep plants shorter than 34 cm. Pod yields were not significantly ($P < .05$) increased by SADH. Weight per pod, pod length, pod diameter and kernel size were decreased by early applications. There were trends toward increased pod and kernel size with 12 week SADH application, but the trends were significant ($P < .05$) only for Florunner pod length and the percentage of Tifspan kernels larger than 7.5 mm diameter in 1972. Multiple SADH application in the "as needed" treatment tended to increase pods per plant and decrease pod and kernel size.

Succinic acid 2,2-dimethylhydrazide* (SADH) is a growth retardant which has been found to reduce vegetative growth of numerous plant species (1,6,7,9,11,12). SADH reduced internode elongation and decreased vegetative growth of peanuts (*Arachis hypogaea* L.) (1,2,3,4). Peanut yields have been increased by SADH in some experiments but have not been affected in others. Size of peanut fruit has also been reduced by SADH in some experiments (1,3,4,13).

Proper timing of SADH applications in relation to plant development could be very important in achieving the desired growth retardation and yield increase. This study was initiated to determine the effects of various times of SADH applications on yields and associated growth characteristics of peanuts.

## Materials and Methods

These experiments were conducted on the Southwest Georgia Branch Experiment Station at Plains from 1970 through 1972. Peanuts were grown on a Greenville sandy-loam using standard cultural practices described earlier (3).

The experimental design in 1970 was a randomized complete block with three replications; in 1971 and 1972 a randomized complete block design with split plots and four replications was used. Peanut cultivars were assigned to whole plots and SADH treatments were assigned to subplots. Duncan's multiple range test was used to test for significant differences among means.

In 1970 plots were three beds wide and 6.1 m long. The center bed was harvested for pod yield and the others were used for sampling during the growing season. In 1971 and 1972 each subplot was two beds wide and 6.1 m long with border beds of the 'Starr' cultivar alternating with the two-bed experimental plots. One bed of each pair was harvested for pod yield and the other bed was used for sampling during the season.

SADH was applied at a rate of 0.95 kg/ha on the dates shown in Table 1. The wettable powder formulation of SADH (85% active ingredient) was applied in an aqueous solution at the rate of 94 l of mixture per ha in 1970 and 188 l per ha in 1971 and 1972. No rain occurred within six hours following any SADH application.

Plant samples were taken from treated and untreated beds, periodically, throughout the growing season. In 1972 samples were also taken from the sample beds for several weeks after the yield beds were harvested. Sample size was usually ten plants per plot, and peg number, pod number and pod weight were determined on a per plant basis.

Peanuts were dug with conventional blades, shaken by hand to remove the soil and inverted to facilitate pod drying. The peanuts were combined with a commercial harvester five to seven days after uprooting at each harvest date. Pods from each plot were bagged, dried, cleaned and weighed for yield determination. Seeds contained approximately 8% moisture when weighed.

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* Marketed for peanuts under the trade name of Kylar by Uniroyal, Inc. of Naugatuck, Conn.

**Table 1. Experimental details of SADH experiments, 1970-1972.**

| Item | Year 1970 | 1971 | 1972 |
|---|---|---|---|
| Planting date | 4-28 | 5-12 | 5-2 |
| Variety | | | |
| Spanish type | Starr | Tifspan | Tifspan |
| Runner type | -- | Florunner | Florunner |
| Plant populations* | | | |
| Spanish type | 210,000 | 162,000 | 262,000 |
| Runner type | -- | 183,000 | 193,000 |
| Dates SADH applied | | | |
| 6 wk | 6-10 | 6-26 | 6-13 |
| 8 wk | 6-26 | 7-8 | 6-29 |
| 10 wk | 7-8 | 7-22 | 7-12 |
| 12 wk | 7-27 | 8-5 | 7-26 |
| As needed | 6-26,7-8 7-27,8-5 | -- | 6-29,7-26 |
| Harvest dates | | | |
| Spanish type | 8-28 | 9-2 | 9-20 |
| Runner type | -- | 9-16 | 9-27 |
| Rain + irrigation from planting to harvest, mm | 605 | 703 | 545 |

* Estimated from plant counts in seedling stage.

Pod lengths were measured on ten randomly sampled, mature, two seeded pods from each treatment in 1971 and 1972. A 500 g pod sample from each plot was taken in 1972 to determine shelling and grade data. The pods were mechanically pre-sized and shelled and the kernels were sized on a series of screens with 19 mm (3/4 inch) long slots to determine kernel size distribution. Screen slot widths for Tifspan kernels were 7.5 mm (19/64 inch), 6.7 mm (17/64 inch) and 5.9 mm (15/64 inch); those for Florunner kernels were 8.7 mm (22/64 inch), 7.9 mm (20/64 inch) and 6.3 (16/64 inch). Other shelling and grading data included the following: shelling percent (total kernel weight/total pod weight x 100), percent sound mature kernels (SMK, whole kernels larger than 5.9 mm and 6.3 mm for Tifspan and Florunner, respectively), percent sound split kernels (SS), percent damaged kernels (DK) and percent other kernels (OK, kernels smaller than 5.9 mm and 6.3 mm for Tifspan and Florunner, respectively).

# Results and Discussion

*Pod Yields.* Yields of Spanish-type cultivars were significantly influenced by SADH only in 1971 (Table 2). Higher yields were obtained in 1971 with the 8-week SADH application than with the 6-week application. This trend was also apparent but not significant in 1970. Florunner yields (Table 2) were not significantly affected by SADH in either year.

**Table 2. Effects of time of SADH application on yields of peanuts.**

| Application time | Yields* Starr 1970 | Tifspan 1971 | Tifspan 1972 | Florunner 1971 | Florunner 1972 |
|---|---|---|---|---|---|
| | kg/ha | kg/ha | | kg/ha | |
| Control | 4694 a | 3418 ab | 5435 a | 5323 a | 6087 a |
| 6 wk | 4206 a | 3318 b | 5378 a | 5435 a | 6052 a |
| 8 wk | 4879 a | 3890 a | 5307 a | 5320 a | 6087 a |
| 10 wk | 4114 a | 3570 ab | 5469 a | 5172 a | 6384 a |
| 12 wk | 4451 a | 3547 ab | 5458 a | 5458 a | 6338 a |
| As needed | 4761 a | -- | 5046 a | -- | 6064 a |

* Seeds contained approximately 8% moisture when weighed. Yields within each column that are followed by the same letter are not significantly different at the 0.05 level.

The effects of SADH on peanut yields have been found to be inconsistent in previous experiments. Brittain (2) found that SADH increased peanut yields in some experiments but not in others. Bauman and Norden (1) and Wynne et al. (13) found no increase in yield due to SADH. Brown and Ethredge (3) showed that SADH increased pod yields of seven peanut cultivars by an average of 20% in 1970, increased yields of only the Spanish-type cultivars in 1971 and had no effects on yields in 1972. They speculated that variations in environmental conditions from year to year could play a part in the erratic response of peanuts to SADH. The research reported here confirms the erratic nature of yield response to SADH.

*Peg and Pod Numbers.* Pegs began to appear on Tifspan and Florunner plants in 1972 at 40 to 45 and 55 to 60 days after planting, respectively, (Figures 1 and 2). The number of pegs increased through 102 days and then decreased. The decrease was particularly apparent in Florunner. Adverse environmental ronditions and/or physiological factors may have caused pegs which had not reached the soil to shrivel and become undiscernible, thus causing the decreases in peg numbers. SADH tended to increase peg numbers of both cultivars beyond 90 days after planting regardless of when it was applied. King (8) observed that SADH tended to decrease peg number on Early Runner peanuts and reasoned that it may be beneficial for SADH to decrease peg number late in the season if more photosynthate could be diverted to the developing pods. Pod number at harvest was only equal to the number of pegs present at 80 to 90 days after planting although all of the harvested pods were probably not initiated at that time.

Pods were discernible about a week or two after peg initiation. Pod numbers increased rapidly until 102 days and then remained nearly constant until harvest. SADH treated plants generally had more pods than untreated plants beyond 90 days after planting. At harvest, pod numbers tended to be increased more by early (6 to 8 weeks) SADH applications than by later SADH applications (Table 3) although differences were not significant (.05 level).

Weight per pod at harvest was reduced by early SADH applications on Spanish type varieties (Table 3). Late SADH applications either had no effect or tended to increase weight per pod. The decreased weight per pod with early SADH application tended to be compensated for by increased pod number per plant. Thus pod weight per plant and harvest yields (Table 2) were not significantly affected by time of SADH application in most cases even though pod weight was altered.

*Pod and Kernel Size.* The time of SADH application influenced pod length, pod diameter and ker-

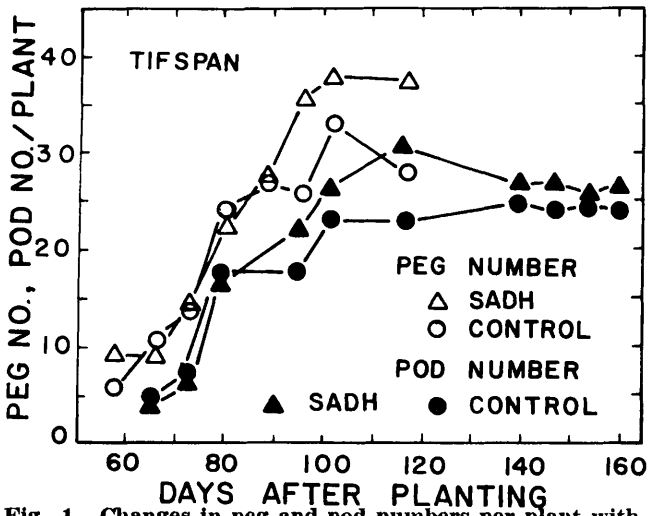


**Fig. 1. Changes in peg and pod numbers per plant with time after planting for the Tifspan cultivar. Points shown for SADH represent averages of all SADH treatments.**

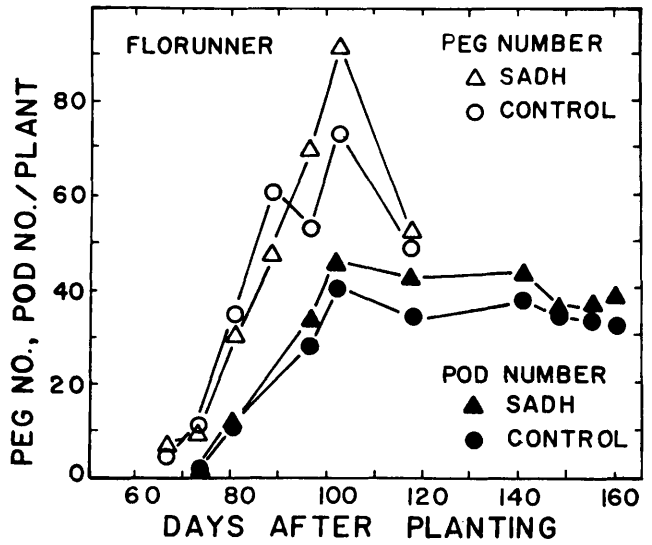


**Fig. 2. Changes in peg and pod numbers per plant with time after planting for the Florunner cultivar. Points shown for SADH represent averages of all SADH treatments.**

nel size. SADH applied to Tifspan plants at 10 to 12 weeks had little influence on pod length, while earlier application times reduced pod length (Table 4). Florunner pod length was increased by the 12-week SADH application in 1972; the 6 and 8-week applications tended to reduce pod length. King (8), Brown et al. (4), and Wynne et al. (13) found similar reductions in pod lengths associated with SADH treatments.

In 1972 pod diameter and kernel size were determined at harvest and it was found that both were altered by SADH (Tables 5 and 6, respectively). Early applications generally reduced the percent of large pods and kernels compared to the late applications. The treatment which had received two SADH applications had the fewest large pods and kernels and the most small pods and kernels.

**Table 3. Effects of time of SADH application on number of pods per plant and weight per pod at harvest.**

| Application time | Starr | Tifspan | | Florunner | |
|---|---|---|---|---|---|
| | 1970 | 1971 | 1972 | 1971 | 1972 |
| | pods/plant | | | | |
| Control | 25 b* | 48 a | 25 a | 40 a | 31 a |
| 6 wk | 29 ab | 56 a | 27 a | 42 a | 36 a |
| 8 wk | 32 a | 50 a | 28 a | 43 a | 36 a |
| 10 wk | 32 a | 45 a | 25 a | 45 a | 33 a |
| 12 wk | 29 ab | 47 a | 25 a | 43 a | 31 a |
| As needed | 32 a | -- | 29 a | -- | 36 a |
| | wt/pod, g | | | | |
| Control | 0.77 ab | 0.71 a | 0.87 a | 1.07 b | 1.15 ab |
| 6 wk | .68 b | .59 b | .80 b | 1.05 b | 1.05 b |
| 8 wk | .85 a | .71 a | .75 c | 1.08 b | 1.06 b |
| 10 wk | .88 a | .73 a | .81 b | 1.39 a | 1.08 ab |
| 12 wk | .86 a | .71 a | .88 a | 1.12 b | 1.20 a |
| As needed | .86 a | -- | .74 c | -- | 1.10 ab |

* Means within each column and characteristic followed by the same letter are not significantly different at the 0.05 level.

**Table 4. Effects of time of SADH application on lengths of mature, two-seeded pods at harvest.**

| Application time | Tifspan | | Florunner | |
|---|---|---|---|---|
| | 1971 | 1972 | 1971 | 1972 |
| | pod length, cm | | | |
| Control | 2.10 a | 2.45 a | 2.63 a | 2.64 b |
| 6 wk | 1.77 b | 2.28 b | 2.36 b | 2.62 b |
| 8 wk | 2.06 a | 2.21 b | 2.48 b | 2.51 c |
| 10 wk | 2.09 a | 2.48 a | 2.65 a | 2.63 b |
| 12 wk | 2.24 a | 2.52 a | 2.62 a | 2.78 a |
| As needed | -- | 1.96 c | -- | 2.56 bc |

* Means within each column followed by the same letter are not significantly different at the 0.05 level.

The percent of sound mature kernels (SMK) included all kernels larger than 5.9 mm for Tifspan and 6.3 for Florunner (Table 6). In both cultivars the treatments which received two SADH applications tended to have the lowest SMK (2 to 3% lower than controls) while the 12-week applications tended to have the highest SMK (2 to 6% higher than controls) (Table 6). The percent of damaged kernels (DK) and sound split kernels (SS) of Tifspan, were increased by the 8-week and "as needed" SADH application. Florunner DK and SS generally were not affected by time of SADH application although the 12-week application had significantly lower percentages of SS and DK.

Shelling percentage was not significantly affected by any of the SADH treatments. This indi-

**Table 5. Effects of time of SADH applications on pod diameter distributions at harvest in 1972.**

| Cultivar | Application time | Pod diameter classes* Large (>12mm) | Medium (>9, <12mm) | Small (<9mm) |
|---|---|---|---|---|
| | | ----------% pods by weight---------- | | |
| Tifspan | Control | 42.2 ab | 47.6 ab | 10.1 ab |
| | 6 wk | 36.5 bc | 53.3 ab | 10.3 ab |
| | 8 wk | 40.8 b | 49.2 ab | 10.7 ab |
| | 10 wk | 45.5 ab | 43.7 c | 10.8 ab |
| | 12 wk | 48.3 a | 43.5 bc | 8.3 b |
| | As needed | 33.8 c | 52.0 abc | 13.8 a |
| Florunner | Control | 75.9 ab | 20.7 ab | 3.4 a |
| | 6 wk | 71.8 ab | 25.4 a | 3.1 a |
| | 8 wk | 71.9 ab | 24.4 ab | 3.9 a |
| | 10 wk | 71.1 ab | 24.8 a | 4.1 a |
| | 12 wk | 78.1 a | 18.6 b | 3.6 a |
| | As needed | 69.6 b | 25.2 a | 5.1 a |

* Means within the same column and cultivar that are followed by the same letter are not significantly different at the 0.05 level.

**Table 6. Effects of time of SADH application on kernel size distributions at harvest in 1972.**

| Cultivar | Application time | Kernel size classes* Large | Medium | Small | Other | SS+DK |
|---|---|---|---|---|---|---|
| Tifspan | | >7.5mm | <7.5mm >6.7mm | <6.7mm >5.9mm | <5.9mm | |
| | | ----------% kernels by weight ---------- | | | | |
| | Control | 49.6 ab | 28.5 ac | 8.8 ac | 6.4 ab | 6.7 a |
| | 6 wk | 46.1 bc | 31.7 ab | 9.6 ab | 5.9 bc | 6.2 a |
| | 8 wk | 45.3 c | 31.2 ab | 9.6 ab | 6.2 abc | 7.7 b |
| | 10 wk | 51.2 a | 25.1 d | 9.0 a | 7.2 ab | 7.5 ab |
| | 12 wk | 55.5 d | 26.5 cd | 7.0 c | 4.9 c | 6.1 a |
| | As needed | 39.0 e | 33.9 b | 11.1 b | 7.4 a | 8.6 b |
| Florunner | | >8.7mm | <8.7mm >7.9mm | <7.9mm >6.3mm | <6.3mm | |
| | | ----------% kernels by weight ---------- | | | | |
| | Control | 24.6 ab | 31.8 a | 32.4 a | 6.6 ab | 4.6 a |
| | 6 wk | 25.1 ab | 30.3 a | 35.3 a | 6.3 ab | 3.0 ab |
| | 8 wk | 20.5 b | 33.0 ab | 34.4 a | 7.6 a | 4.5 a |
| | 10 wk | 23.1 ab | 35.4 bc | 29.8 a | 6.7 a | 5.0 a |
| | 12 wk | 26.9 a | 36.1 c | 31.3 a | 4.3 b | 1.5 b |
| | As needed | 21.4 b | 34.9 bc | 30.9 a | 7.6 a | 5.2 a |

* Kernel size classes refer to screen slot widths. SS and DK mean sound split and damaged kernels, respectively. Means within each column that are followed by the same letter are not significantly different at the 0.05 level.

cated that the hull weight-kernel weight ratio remained relatively constant as pod size was increased or decreased by the time of SADH application. Mean shelling percentages were 75.6 and 77.7 for Tifspan and Florunner, respectively.

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