# Effect of Ethrel Seed Treatment on Growth, Yield, and Grade of Two Virginia-Type Peanut Cultivars[1]

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**ABSTRACT**

Two virginia-type peanut (*Arachis hypogaea* L.) cultivars, NC 6 and NC 7, were observed to germinate slowly under field conditions. Three seed treatments (1%, 5%, and 10%) of ethrel, cis-N-((1,1,2,2-tetrachloroethyl)thio)4-cyclo-hexene-1,2-dicarboximide, were prepared with a recommended seed treatment (45% Difolitan and 25% PCNB) and dusted on the seed. The experimental design was a 2 (cultivars) x 4 (3 ethrel treatments and an untreated check) factorial in a randomized complete block with four replications. The experiment was conducted for 2 years (1980 & 1981) at two locations (Suffolk, VA, and Beltsville, MD). Factors studied were: Stand counts (10 and 14 days after planting), plant dry weight (18 and 42 days after planting), pod yield, grams/100 seed, and percentages of meat, total sound mature kernels, extra large kernels, and fancy pods. No significant differences were found among ethrel treatments for any factor, except stand counts. Plots planted with ethrel-treated seed had significantly higher stand counts at 10 and 14 days than plots not planted with ethrel-treated seed. Significant differences occurred between locations for all factors, and between years for all factors, except stand counts at 14 days and grams/100 seed. Significant differences occurred between cultivars for all factors, except plant dry weight at 18 days, pod yield, and percentage of fancy pods. These results indicate that, while stands may be improved with ethrel-treated seed, no significant effects on yield or grade factors were found.

Key Words: Groundnut, *Arachis hypogaea* L., germination, stand counts, plant dry weight, seed dormancy.

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The effects of ethylene or ethylene releasing materials such as Ethrel or Ethephon or CEPA (2-chloroethylphosphonic acid) on germination of peanuts (*Arachis hypogaea* L.) has been studied for over 20 years. Ketring *et al.* (8) and Sanders *et al.* (9) have extensively reviewed the effects of ethylene on the germination, flowering, pegging, and growth of peanuts. Previous studies (1, 2, 3, 6, 10) have shown that ethylene could be used to break dormancy and increase germination of peanuts. Ethrel has been successfully combined either as a slurry or dust with seed fungicides to break dormancy as early as 60 days prior to planting (2, 3, 6). Ketring (6) concluded that for virginia- and runner-type peanuts a 1% (w/w) ethrel powder and fungicide mixture was best.

Ketring and Morgan (7) found that as dormancy decreases ethylene production increases, while Ketring (4) found that decreased ethylene production was associated with decreased germination. Ketring (5) concluded that ethylene was involved in protein synthesis either at the translation level from stable messenger RNA or at the DNA transcription level.

Two large-seeded virginia-type peanut cultivars (NC 6 and NC 7) had been observed to germinate slowly in growers' fields. The slow germination did not appear to be due to poor seed quality or environmental conditions at planting time. One possible explanation could be extended seed dormancy. Therefore, this experiment was initiated to determine if ethrel used as a seed treatment would enhance germination and growth of NC 6 and NC 7 peanut cultivars in the field.

## Materials and Methods

The experiment was conducted for 2 years (1980 and 1981) in the field at two locations, the Tidewater Research Center (TRC) at Suffolk, Virginia, and the Beltsville Agricultural Research Center (BARC) at

Beltsville, Maryland. The soil types were a Suffolk loamy sand (fine-loamy, siliceous, thermic Typic Hapludult) at TRC in 1980 and 1981 and an Evesboro sandy loam (mesic, coated Typic Quartzipsamments) at BARC in 1980 and 1981. The experimental design was a 2 x 4 factorial in a randomized complete block with four replications. Factor 1 consisted of the two cultivars used--NC 6 and NC 7. Factor 2 consisted of the ethrel, cis-N-((1,1,2,2-tetrachloroethyl)thio)4-cyclo-hexene-1,2-dicarboximide, concentrations used--0%, 1%, 5%, and 10%. The ethrel was mixed with a recommended seed treatment (45% Difolitan and 25% PCNB) in order to obtain the concentrations used and dusted on the seed prior to planting. Plots were two rows, 1.8 m wide and 6.1 m long. Recommended production practices for producing high yielding peanuts were used at both locations.

The characteristics studied were: number of plants per plot at 10 and 14 days after planting, plant dry weight at 18 and 42 days after planting, pod yield (kg $ha^{-1}$) at harvest, grams per 100 seed, and percentages of meat, total sound mature kernels, extra large kernels, and fancy pods. Data were analyzed by analysis of variance and Duncan's new multiple range test.

Soil moisture of the top 10 cm at planting was determined each year by drying in a forced draft oven at 60 C for 48 h. Soil temperature (10 cm) at planting through 5 days after planting was also obtained. Peanuts were planted the third week of May at TRC and the fourth week of May at BARC with harvest dates ranging from 136 to 144 days after planting.

**Table 1. Soil moisture and temperature data and dates of planting and harvesting peanuts at two locations, Suffolk, Virginia (TRC), and Beltsville, MD (BARC), for 2 years (1980 and 1981).**

| Factor | TRC | | BARC | |
|---|---|---|---|---|
| | 1980 | 1981 | 1980 | 1981 |
| Soil Mois. (%) AP[1/] | 2.8 | 5.3 | 5.7 | 5.9 |
| Soil Temp: (°C) DAP | | | | |
| 0 | 27.8 | -- | 22.2 | 22.8 |
| 1 | 28.3 | 20.9 | 26.1 | 25.0 |
| 2 | 25.5 | 26.6 | 26.1 | 25.0 |
| 3 | 28.9 | 28.9 | 26.1 | 26.1 |
| 4 | -- | 33.3 | 28.9 | 27.8 |
| 5 | 23.3 | 26.1 | 31.1 | 28.9 |
| Mean | 26.8 | 28.8 | 26.8 | 25.9 |
| Planting Dates | 5/15 | 5/22 | 5/27 | 5/26 |
| Harvest Dates | 9/29 | 10/13 | 10/10 | 10/14 |
| Growing Days | 137 | 144 | 136 | 141 |

[1/] AP and DAP = at planting and days after planting, respectively.

## Results and Discussion

Soil moisture and temperature were adequate for seed germination (Table 1). Analyses of variance for plants/plot at 10 and 14 days after planting (DAP) gave significant ($P<0.01$) F values for locations at 10 and 14 DAP, years at 10 DAP, cultivars at 10 and 14 DAP, ethrel concentrations at 10 and 14 DAP, location x year interaction at 10 DAP, location x cultivars interaction at 10 DAP, and location x ethrel concentration interaction at 10 and 14 DAP (Table 2). The location x cultivar interaction was significant ($P<0.05$) at 14 DAP.

The number of plants/plot at 10 DAP with ethrel concentration (Table 3). Plots planted with untreated seed had significantly fewer plants than plots planted with ethrel-treated seed. Plots planted with 10% ethrel-treated seed had significantly more plants than the untreated or 1% ethrel-treated plots. No significant differences among plots planted to ethrel-treated seed were found at 14 DAP. However, all ethrel plots were significantly higher than untreated plots. The significant ($P<0.01$) location x ethrel concentration interactions at 10 and 14 DAP was due to the fact that at TRC the 1% ethrel plolts were highest in plants/plot, while at BARC

**Table 2. Analyses of variance for number plants/plot, plant dry weight (g) and pod yield (kg $ha^{-1}$) at two locations (Suffolk and Beltsville) and 2 years (1980 and 1981).**

| Factor | Plants/Plot | | Plant Dry Wt. | | Yield |
|---|---|---|---|---|---|
| | 10 DAP | 14 DAP | 18 DAP | 42 DAP | Kg $ha^{-1}$ |
| Locations (L) | ** | ** | ** | ** | ** |
| Years (Y) | ** | NS | ** | ** | ** |
| Cultivars (C) | ** | ** | NS | ** | NS |
| Ethrel Conc. (E) | ** | ** | NS | NS | NS |
| L x Y | ** | NS | ** | ** | ** |
| L x C | ** | • | NS | • | NS |
| L x E | ** | ** | NS | NS | NS |
| L x C x E | NS | NS | NS | NS | • |

*, **, NS Significant at 0.05, 0.01, and not significant at 0.05 levels, respectively. Interactions not shown in table were not significant at 0.05 level.

**Table 3. Means of number of plants/plot, plant dry weight (g), and pod yield for four ethrel concentrations, two cultivars, two locations, and 2 years.**

| Factor | Plants/Plot | | Plant Dry Wt. | | Yield |
|---|---|---|---|---|---|
| | 10 DAP | 14 DAP | 18 DAP | 42 DAP | Kg $ha^{-1}$ |
| Ethrel Conc. | | | | | |
| 0% | 53.8 C[1/] | 76.2 B | 9.9 AB | 36.2 AB | 3226 A |
| 1% | 58.9 B | 81.0 A | 10.1 A | 37.7 A | 3293 A |
| 5% | 60.6 AB | 83.0 A | 9.8 AB | 36.1 AB | 3228 A |
| 10% | 63.7 A | 84.6 A | 9.3 B | 33.6 B | 3197 A |
| Cultivars | | | | | |
| NC 6 | 51.8 B | 76.4 B | 9.7 A | 33.8 B | 3187 A |
| NC 7 | 66.7 A | 86.0 A | 9.8 A | 38.0 A | 3285 A |
| Locations | | | | | |
| TRC | 33.8 B | 59.4 B | 10.4 A | 29.0 B | 3143 B |
| BARC | 84.6 A | 103.0 A | 9.1 B | 42.8 A | 3329 A |
| Years | | | | | |
| 1980 | 47.1 B | 80.1 A | 6.8 B | 41.0 A | 2404 B |
| 1981 | 71.3 A | 82.3 A | 12.7 A | 30.8 B | 4068 A |

[1/] Means within columns and main factors followed by the same letter are not significantly different at 0.05 level according to Duncan's New Multiple Range Test.

the number of plants increased with increased ethrel concentration.

Analyses of variance for plant dry weight at 18 and 42 days after planting gave significant ($P<0.01$) F values for locations at 18 and 42 DAP, years at 18 and 42 DAP, cultivars at 42 DAP, and the location x year interaction at 18 and 42 DAP (Table 2). The location x cultivar interaction was significant ($P<0.05$) at 42 DAP. The 1% ethrel treatment was significantly higher for plant dry weight than the 10% treatment at 18 and 42 DAP (Table 3). Ketring (6) has also reported stunting of growth at ethrel concentrations above 1%. He also found that growth was retarded at the 1% concentration, but the effect was overcome by the time of emergence. The higher plant dry weight at 42 DAP at BARC may have been due to peanuts emerging 5 days earlier at BARC than at TRC. The significant ($P<0.01$) location x year interactions for plant dry weight at 18 and 42 DAP were due to higher plant dry weights at TRC in 1981 and at BARC in 1980.

Analyses of variance for pod yield gave significant ($P<0.01$) differences for locations, years, and the locations x years interaction (Table 2). The location x cultivar x ethrel concentration interaction for pod yield was significant ($P<0.05$). No significant differences occurred between cultivars or among ethrel concentrations for yield (Table 3). The location x cultivar x ethrel concentration interaction for pod yield was due to the fact that at TRC NC 6 treated with 5% ethrel was highest among the NC 6 plots, while NC 7 treated with 1% ethrel was highest

among the NC 7 plots. At BARC NC 6 treated with 1% ethrel was highest among the NC 6 plots, and NC 7 treated with 10% ethrel was highest among the NC 7 plots.

Analyses of variance for percentage of fancy pods gave significant ($P<0.01$) differences for locations, years, and the locations x years interaction (Table 4). The year x cultivar and location x year x cultivar interactions were significant ($P<0.05$). No significant differences occurred between cultivars or among ethrel concentrations for percentage of fancy pods (Tables 4 and 5).

**Table 4. Analyses of variance for seed weight and percentages of fancy pods, extra large kernels (ELK), meat, and total sound mature kernels (TSMK) at two locations (Suffolk and Beltsville) and 2 years (1980 and 1981).**

| Factor | Seed Wt. g/100 | Fancy Pods % | ELK % | Meat % | TSMK % |
|---|---|---|---|---|---|
| Locations (L) | ** | ** | ** | ** | ** |
| Years (Y) | NS | ** | ** | ** | ** |
| Cultivars (C) | ** | NS | ** | ** | ** |
| Ethrel Conc. (#) | NS | NS | NS | NS | NS |
| L x Y | ** | ** | ** | ** | NS |
| Y x C | NS | * | * | ** | ** |
| L x Y x C | NS | * | NS | NS | NS |
| L x C | ** | NS | NS | ** | ** |
| Y x C x E | NS | NS | NS | NS | * |
| Y x E | NS | NS | NS | ** | NS |

*, **, NS significant at 0.05, 0.01, and not significant at 0.05 levels, respectively. Interactions not shown in table were not significant at 0.05 level.

**Table 5. Means of seed weight and percentages of fancy pods, extra large kernels (ELK), meat, and total sound mature kernels (TSMK) for four ethrel concentrations, two cultivars, two locations, and 2 years.**

| Factor | Seed Wt. g/100 | Fancy Pods % | ELK % | MEAT % | TSMK % |
|---|---|---|---|---|---|
| Ethrel Conc. | | | | | |
| 0% | 92.4 A[1/] | 87.4 A | 44.5 A | 70.4 A | 61.4 A |
| 1% | 92.6 A | 88.6 A | 44.7 A | 70.5 A | 61.8 A |
| 5% | 91.3 A | 88.1 A | 45.2 A | 70.2 AB | 61.9 A |
| 10% | 93.0 A | 87.8 A | 43.6 A | 69.4 B | 61.2 A |
| Cultivars | | | | | |
| NC 6 | 87.5 B | 87.6 A | 38.5 B | 68.6 B | 60.1 B |
| NC 7 | 97.2 A | 88.3 A | 50.5 A | 71.7 A | 63.1 A |
| Locations | | | | | |
| TRC | 89.3 B | 91.3 A | 41.7 B | 68.9 B | 62.5 A |
| BARC | 95.3 A | 84.6 B | 47.3 A | 71.3 A | 60.6 B |
| Years | | | | | |
| 1980 | 92.7 A | 85.3 B | 41.9 B | 68.1 B | 58.8 B |
| 1981 | 92.0 A | 90.7 A | 47.1 A | 72.1 A | 64.3 A |

1/ Means within columns and main factors followed by the same letter are not significantly different at 0.05 level according to Duncan's New Multiple Range Test.

The significant locations x years interaction occurred because TRC was higher in percentage of fancy pods in 1981 than BARC, while BARC was higher in 1980 than TRC. The significant cultivar x year interaction occurred because NC 6 was higher in percentage of fancy pods in 1980 than NC 7, while in 1981 the reverse occurred. The location x year x cultivar interaction occurred because NC 7 was higher than NC 6 in percentage of fancy pods at each location and year, except 1980 at BARC.

Analyses of variance for the seed size characteristics as measured by grams/100 seed and percentage of extra large kernels gave significant ($P<0.01$) differences for locations, cultivars and the location x year interaction (Table 4). Significant ($P<0.01$) differences also occurred for the location x cultivar interaction for grams/100 seed and years for percentage of extra large kernels. A significant ($P<0.05$) year x cultivar interaction occurred for percentage of extra large kernels. No significant differences occurred due to ethrel concentration for grams/100 seed or percentage of extra large kernels (Table 5).

The significant location x year interaction for seed weight resulted from a significantly heavier seed weight produced at BARC than at TRC in 1980. Seed weights at TRC and BARC were not significantly different in 1981. The significant location x cultivar interaction occurred because the seed weight of NC 7 at BARC was 102 g/100 seed as compared to only 93 g/100 seed at TRC. The seed weight of NC 6 was 86 g/100 seed at TRC and 89 g/100 seed at BARC. The interaction (location x year) was also significant ($P<0.01$). This interaction resulted because the percentage of extra large kernels was significantly larger at BARC than at TRC both years and was larger at both locations in 1981 than in 1980. The interaction (year x cultivar) was significant ($P<0.05$) because the percentage of extra large kernels for NC 7 was significantly higher than for NC 6 both years and for both cultivars in 1981 than in 1980.

Analyses of variance for the seed quality traits--percentages of meat and total sound mature kernels gave significant F values ($P<0.01$) for locations, years, cultivars, the location x cultivar interaction, and the year x cultivar interaction (Table 4). Significant F values ($P<0.01$) for location x year and year x ethrel concentration interactions were also found for the percentage of meat. A significant ($P<0.05$) year x cultivar x ethrel concentration interaction was found for percentage of total sound mature kernels. The 0 and 1% ethrel concentrations were significantly higher than the 10% ethrel concentration for percentage of meat, but no differences were observed for percentages of total sound mature kernels (Table 5).

The location x cultivar interaction for percentage of total sound mature kernels occurred because NC 7 had a significantly higher percentage of total sound mature kernels than NC 6 at TRC, but not at BARC. Similar results were obtained for location x cultivar and year x cultivar interactions for percentage of meat and year x cultivar interaction for percentage total sound mature kernels. The location x year interaction for percentage of meat was due to the larger effect of years on percentage of meat at TRC than at BARC.

The year x ethrel concentration interaction for percentage of meat was due to inverse yearly differences in percentages of meat for the 5 and 10% ethrel concentrations (Table 5). The year x cultivar x ethrel concentration interaction for percentage of total sound mature kernels was due to decreased percentage of total sound mature kernels with increased ethrel concentration for NC 7 in 1980, while the percentage of total sound mature kernels increased with increased ethrel concentration for NC 7 in 1981.

Some of the interactions between locations and years may have been due to varying soil temperature and moisture conditions at planting or during germination. However, soil temperatures were similar at both locations and both years (Table 1). Soil moisture at planting was

significantly lower at TRC in 1980 than at TRC in 1981 or BARC in 1980 and 1981. However, a rain shortly after planting in 1980 probably masked any real difference due to soil moisture.

In summary, locations, years, and cultivars affected plant dry weight, pod yield, grams/100 seed, and percentages of meat, total sound mature kernels, extra large kernels and fancy pods more than ethrel seed treatment. Seed treatment with ethrel did significantly affect plant counts at 10 and 14 days after planting, but not as much as location, years and cultivars. The location x ethrel concentration interaction was also significant for stand counts. However, the interactions could not be readily explained by differences in soil temperatures or soil moistures at planting. These results indicate that environment is important when using ethrel as a seed treatment. The interactions among ethrel concentrations, cultivars, and environments require careful evaluation before making recommendations on the use of ethrel as a seed treatment.

While dormancy may be a factor in slow field emergence of NC 6 and NC 7, since ethrel did increase stand counts, additional work is needed to better define the cause of slow field emergence in NC 7 and especially NC 6. Other factors such as the temperatures and relative humidities to which peanuts are subjected after harvest can influence dormancy and germination (9). Additional work is also needed to determine if the increase in rate of emergence due to ethrel under some conditions is cost effective, since yields and grades at harvest were not significantly different among treated and untreated plots. Besides those listed above, items to be considered in determining cost effectiveness are: 1) the cost of the material; 2) ease and cost to seedsmen of applying ethrel during the seed treating process; 3) acceptability to growers of higher seed costs to aid in obtaining uniform stands; and 4) potential benefits in weed control from a uniform stand that is established sooner.

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