INFLUENCE OF SEVERAL PLANT GROWTH REGULATORS

IN SOYBEANS AND SPANISH PEANUTS

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CHAPTER I

INTRODUCTION

With a steadily-increasing world population, a potential worldwide food shortage is becoming more of a reality. This is one reason why there is an increasing need for research and development in agriculture. One method of increasing the production of crops which has shown considerable potential and has aroused much interest in recent years is the use of chemicals to regulate plant growth. The possibility of using plant growth regulators to increase yields, improve tolerance to environmental stress, and improve the quality of existing crops and cultivars, shows increasing promise.

Most plant growth regulators currently on the market today are primarily used on ornamental and horticultural crops. They modify the normal growth of fruits and vegetables in several ways. Growth regulators have promoted earlier coloration and maturity on some plants. They have been able to loosen the fruit for a more efficient and earlier harvest. In addition, growth regulators have caused dormant buds to become fertile, resulting in increased fruit yields (54).

Since growth regulators have shown that they will influence the growth of ornamental and horticultural crops, interest in what their effect might be on field crops such as soybeans and peanuts has become more prominent in recent years. Perhaps growth regulators could be used to raise the lower pods on soybean plants so that when harvested, these lower pods would not be missed by mechanical harvesters. Growth regulators might cause infertile flowers to become fertile (thereby increasing the number of pods per plant) or promote flower development from dormant buds. Growth regulators might also aid in decreasing the degree of pod shattering of soybeans. If excessive vine growth of peanut plants could be reduced by growth regulators, more effective mechanical operations later in the growing season might be possible. Mechanical operations such as tillage or the application of a pesticide could perhaps be conducted without damaging the peanut plants. Another possibility of plant growth regulator use on peanuts might be to cause flowering at more nodes and the production of a peg at each node for increased pegging or to stop flowering so that immature peanuts would not reduce quality. Perhaps these growth regulators could be used to increase quality as well as quantity of both soybeans and peanuts.

Currently there are no growth regulators with federal approval for use on soybeans. SADH (Table I) is the only growth regulator approved for use on Spanish peanuts.

The objectives of these studies were (a) to examine the effects of plant growth regulators on the growth habits of soybeans and Spanish peanuts and (b) to evaluate the yield response when soybeans and Spanish peanuts were treated with growth regulators in the field.

TABLE I

PLANT GROWTH REGULATORS AND HERBICIDES CITED IN THIS RESEARCH

Common, Code Name, or Trade Name	Chemical Name
Plant Growth Regulator	
Chlormequat	2-chloroethyltrimethyl ammonium chloride
Culbac	Chemistry not known
Cytex	Chemistry not known
Ethephon	2-chloroethylphosphonic acid
Maleic Hydrazide	1,2-dihydro-3,6-pyridazinedione
Mefluidide	N-[2,4-dimethyl-5-[(trifluoromethyl) sulfonyl]-amino phenyl acetamide
Morphactin	Mixture of 9-hydroxyfluorene-9-carboxylate derivatives
NC-9634	(3-phenyl-1,2,4-thiadiazol-5-yl)-thio acetic acid
SADH	Succinic acid, 2,2-dimethylhydrazide
TIBA	2,3,5-triiodobenzoic acid
Herbicides	
Butralin	4-(1,1-dimethylethyl)-N-(1-methyl-propyl)-2,6-dinitrobenzenamine
Trifluralin	α,α,α-trifluro-2,6-dinitro-N,N-dipropyl-p-toluidine

CHAPTER II

LITERATURE REVIEW

Research on the use of either natural or synthetic chemicals which alter plant growth has been under investigation for many years. Since the early 1930's when growth regulators were first identified as significant to plant growth, the challenge of their possibilities has been of interest. Wittwer (54) has summarized the history of growth regulators since the 1930's to the 1970's. Some of the first growth regulating chemicals discovered were the auxins. Much investigation has been conducted since 1935 with the chemical structures of auxins as related to biological growth response (49).

It may now be stated with reasonable certainty that indole-3-acetic acid (IAA) is the principle compound of auxin (31). A milestone in the commercial use of growth regulators, according to Wittwer, was passed 1944 when Hammer and Tukey announced the herbicidal effects of 2,4-dichlorophenoxyacetic acid (2,4-D) and 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) (54). Another naturally occurring plant hormone, along with IAA, is gibberellin. Best known of the gibberellins, commercially produced by fermentation from fungal structures, is gibberellic acid (GA_3) (44). The primary action of gibberellin is on stem elongation. Stem elongation is a consequence both of increased cell multiplication and of an increase in cell size (49).

The finding of the cytokinins, also naturally occurring hormones, is fairly recent. For now their commercial usefulness is limited to the favorable effects of prolonging the storage life of green leafy vegetables (53). Physiological roles of cytokinins include not only being necessary for cell growth and differentiation but also being inhibitory to senescence. Cytokinins also have the capacity to direct the flow of chemicals through the plant (44).

During the 1950's and 1960's several synthetic growth regulators were developed, such as maleic hydrazide, chlormequat, SADH, and TIBA (Table I). Growth regulators have been used extensively for modification of growth in flower and ornamental species (16).

Studies on the plant growth regulating activity of certain ammonium, phosphonium and sulphonium halides (39), halogen-substituted benzoic acid (30), and 1,1-dichloro-2-phenoxy-ethanes, α,α-dichlorotoluenes, and 1,1-dichloro-2-phenylethanes (32) have been conducted in recent years. All of these chemicals have shown some type of growth regulating properties, and might be opening new approaches for future growth regulating compounds. Ethylene inhibited the movement of both auxins in stem tissue and IAA in petiole tissue (41). Morgan et al. (42) reported ethylene production was stimulated with the application of the synthetic growth regulator, ethephon (Table I). The stimulation of germination of witchweed (Striga lutea Lour.) seeds with the use of ethylene and ethephon was shown by Egley and Dale (19). The authors concluded that germination of aged seeds was stimulated by ethylene, ethephon, and mixtures of both. Burg et al. (13) concluded that ethylene and ethylene producing chemicals inhibit cell division, slow growth if applied during the stage of cell division, and inhibit secondary growth and lateral root formation. They also concluded that ethylene stimulated growth if applied after cell division has been completed, stimulated root hair formation, and enhanced growth in certain cell tissue cultures and in pollen tubes.

Soybeans

The use of plant growth regulators to modify crop growth has been more successful with soybeans [Glycine max (L.) Merr.] than with most other field crop species (4). Greer and Anderson (22) reported that soybeans treated with TIBA at various rates and stages branched more than did untreated plants. Plant maturity was also effected by TIBA applications of 10 and 50 ppm applied before flowering. In addition, the usual result has been a small decrease in seed size and an increase in seed number if an increase in seed yield was obtained with a TIBA treatment. Burton and Curley (14) indicated that the effects of TIBA treatments were apparent 2 weeks following application to soybeans and were typical of those described by Greer and Anderson (22). The leaves appeared smaller, vertically oriented, darker green, and crinkled between the veins. Plants showed increased branching, shortened internodes, and pointed or conical canopy. Wax and Pendleton (51) reported that soybean yields increased as row spacing decreased from 102 to 25 cm when TIBA was applied at 70 g/ha to indeterminate soybeans. Hume et al. (28) summarized that positive yield responses are most likely to result from TIBA application in years when moisture has been readily available during the preflowering period and temperatures have been normal or above normal. Hichs et al. (25) reported on the effects of TIBA with high fertility levels. The authors stated that plant height of soybeans was reduced 33% by TIBA application at 70 g/ha. They also stated that since the number of internodes was not significantly affected, the reduction in plant height observed on TIBA treated plots was due to shorter internodes, not fewer internodes. The addition of fertilizers did not affect soybean yield on this highly productive soil. Bauer et al. (5) also found that most of the reduction in the height of treated soybeans was due to a decrease in internode length; however, if the TIBA rate was too high, treated plants had fewer nodes. Closely related to the decreased height of TIBA treated plants is their increased resistance to lodging, and is likely a result of treated plants having shorter, stronger internodes, and a lower center of gravity. Anderson (1) noted that in the determinate type of soybean, TIBA alters the shape of the plants and decreases lodging when applied 6 weeks after planting. With determinate soybeans, TIBA has not increased seed yields except when lodging was a problem. Tanner and Ahmed (46) concluded that one manifestation of TIBA action was the changing of the distribution of photosynthate between vegetative and reproductive growth, rather than by increasing total photosynthesis through increased efficiency of light utilization of a modified canopy. That is, the chemical acts to slow down vegetative growth and promote reproductive growth. Presumably this explains the greater production and retention of pods in TIBA-treated plants.

Blomquist and Kust (8) reported that ethephon increased translocation of ethylene to the pods of the treated leaf on a dry weight basis. The authors concluded that the increase did not seem to be substantial enough to be interpreted as an increase in movement of photosynthate to filling pods, but rather to expanding vegetative tissues.

By noting observations on growth and lodging of soybeans throughout the growing season, Blomquist et al. (9), found that plants treated with ethephon were shorter than untreated plants. Height of soybean plants was decreased as concentration of ethephon applied increased. Ethephon also decreased the degree of lodging of the soybean plants. Anatomical studies revealed no gross changes in anatomy due to treatment with ethephon. Seed yield was not significantly changed by treatment with ethephon. However, plants were harvested with small plot mowers and seed losses were minimized by hand cleaning. If the plots had been harvested with a field combine, seed losses of untreated plots would have occurred. Basnet et al. (4) stated that none of the growth regulators tested appeared too promising by themselves for commercial soybean production. Slife and Earley (45) applied ethephon to soybeans at 0.56, 1.12, and 2.24 kg/ha, weekly for six weeks. The average reduction in yield of seeds/ha for each application date and rate were 25.9, 32.1 and 16.8%, respectively, as compared to the untreated check. It was not determined whether ethephon reduced the rate of stalk elongation by decreasing the rate of cell division or rate of cell enlargement. The authors described a decrease in percent lodging and a height reduction of soybean plants treated with ethephon. Also noted was a delayed leaf drop from mature soybean plants, when ethephon was applied at rates of 0.56, 1.12, and 2.24 kg/ha.

Howell et al. (27) expressed an interest in the effect of gibberellin on soybeans, since gibberellin promotes growth of intact plants. The authors attempted a gibberellin seed treatment on soybeans, and discovered that the gibberellin treated seeds caused earlier germination and stimulated growth until the pod-set stage. No increase in yield was obtained in these studies. To be economically useful, chemical treatment of a crop should result in increased yield or in other production benefits without serious loss of yield. Gibberellin as applied to the seed in field experiments did not show this. Neither has it proved beneficial when applied to the soil, on seedlings, or on the foliage at various stages through flowering.

Another growth regulator applied to field grown soybeans was naphthaleneacetic acid (NAA). The first visible effect of NAA on treated soybean plants was epinasty of the upper part of the stem and of some of the petioles. This effect could be seen one hour after treatment with NAA at rates of 100 up to 500 ppm and lasted for approximately 24 hours. With subsequent treatments, the epinasty became less noticeable. Application at a prefloral stage decreased branching and delayed flowering. Multiple applications of NAA or its amide applied during prefloral stages of soybean development caused plants to differentiate large stems which reduced lodging. The lowest pods of the treated plants were higher above the soil surface then those of control plants (29). Schaik and Probst (50) reported that NAA applied at 1000 ppm when the first flower opened and continued for three weeks until flowering ended, had no significant effect on total pods, pods per node, seeds per pod, or weight of 100 seeds.

The effect of NC-9634 (Table I) on the development and yield of determinate soybeans has been recorded by Blem et al. (7). Data suggested that 'Forrest' cultivar soybeans were more responsive to the chemical than 'Davis'. Although there was a visible growth response there was no significant yield increase. A reduction in total number of flowers was noticed; however, more mature pods among plants was obtained at 0.28 and 0.56 kg/ha rates of NC-9634.

Peanuts

SADH has been remarkably successful on several horticultural crops, and is highly promising for promoting rootings of several ornamental species (15). SADH has been found to enhance the onset of maturity and to retard growth of a wide variety of plants as well as to increase drought tolerance and strengthen the stems of certain species (52). A modification of the position of the side branches of peanut (Arachis hypogaea L.) plants by SADH applications was recorded by Halevy et al. (23). Wittwer (54) reported that peanuts showed increased yields, promotion of higher grade nuts, and showed a greater drought resistance when treated with SADH. Preliminary treatment with SADH of conventionally spaced peanut plants (91 cm rows) produced no differences in yield. It was noted at harvest that untreated rows were overlapping, while 20 to 30 cm of canopy was unoccupied between treated rows Peanuts densely spaced with 46 cm rows and treated with SADH produced greater yields of fruit than untreated plants at the same spacing (10). The greatest yield increase was the runner-type peanut. Brown and Ethredge (12) reported yield increases by an average of up to 20% with the application of SADH. This yield increase was due to an increase in the number of pods per plant, since weight of 100 pods was not affected. Hammerton (24) stated that the effect on yield with a SADH application was small. The author noted that there was some tendency to increase the number of pods while reducing pod size; mean seed weight was also reduced. The principle modification noted was a reduction of internode length, both on mainstem and branches, and production of darker green leaves. The number of nodes (and hence of leaves) was affected only temporarily, if at all. Morris (43) conducted experiments to determine the effects of SADH and three row spacings on Spanish peanuts. A reduction in peanut yields by the application of SADH was noted at all three row spacings. The effects of SADH on peanut yields have been found to be inconsistant. Daughtry et al. (18) studied the effects of time of application of SADH on yield of both runner-type and Spanish peanuts. They obtained erratic and inconsistant yield results, and speculated that variations in environmental conditions from year to year could play a part in the erratic response of peanuts to SADH. Excessive vine growth makes disease control and harvesting of peanuts more difficult and possibly reduces yield due to channeling of energy into vegetative rather than reproductive growth. The peanut crop may also be subject to harvesting losses resulting from the breakage of the peg (6). The most consistant effect on peanuts has been the reduction of stem length. Wu and Santelmann (56) stated that SADH appears to have the potential as a vine growth control agent. The authors observed a more compact, robust looking plant with SADH treated Spanish peanut plants. A reduction of 30 to 40% in height of SADH treated peanut plants was noted by Brown et al. (11), 103 days after planting. The authors concluded that the reduction in stem length caused by SADH was attributable mainly to shorter internodes. Gorbet and Rhoads (21) determined that the reduction in vine growth attributed to SADH would favor better coverage of late season fungicide applications and less difficulty in digging the peanuts. Hodges and Perry (26) noticed a lower degree of pod shedding when SADH was applied to peanuts at various treatment dates. They concluded that peanut cultivars having poor pod retention may show the greatest yield increase with SADH, especially if conditions favoring pod shedding occur at harvest time. The time of application of SADH, seed size, and position of the seed in the pod appeared to have little effect on percent germination or rate of respiration (17). No differences in maturity of peanut plants was noticed with SADH treatments by Wynne et al. (51).

A hormonal role for ethylene in germination of non-dormant seeds is suggested by the observations of rapid ethylene evolution during early stages of germination by the actively growing organs of Spanish-type peanut seeds, and of stimulation of germination and growth of dormant seeds by ethylene (33). Ketring and Morgan (35) obtained support of the concept that ethylene is a substance directly involved in the release of dormancy of Virginia-type peanut seeds, rather than a product resulting from germination. Ethephon in water at a concentration of 10^{-2} M was highly effective in stimulating germination of dormant cured Florunner peanut seed (2). Ethephon was highly effective in inducing dormant Virginia-type peanut seeds to germinate promptly, with the seeds that were no longer dormant producing ethylene during germination (3,34). Ketring (37) reported that concentrations of 0.5, 1, 3, and 5% ethephon released the seeds from dormancy and at least 90% emergence was achieved. However, the 1% ethephon provided the most rapid rate of emergence.

Mefluidide (Table I) has shown promise as a chemical regulant of vegetative and reproductive growth patterns (20). Other growth regulating activity include grass retardation and seedhead suppression, tree and ornamental growth retardation, sugar content enhancement, and yield increases in certain crops (40). Wu (55) reported some leaf roll from mefluidide treated peanut plants; however, mefluidide reduced plant size only at the highest rate used (0.84 kg/ha). Other reports have shown a reduction in both height and width with the application of mefluidide to peanuts. When applied at the late flowering to early pegging stage at 0.84 kg/ha rate a height reduction resulted. A width reduction was obtained at the 0.84 kg/ha rate at the 3 to 7 pegs per stem stage, but not at the earlier stage mentioned above (47,48). No significant differences in yield of peanuts has been reported (47,48,55).

Investigation of another growth regulator, morphactin (Table I), is being analyzed on peanuts (36). In early flowering treatment, morphactin (1000 ppm) had a late period of increased cumulative flowering. Morphactin stimulated pegging and inhibited shoot fresh weight of mature seeds, but caused reduction in yield (38).

CHAPTER III

METHODS AND MATERIALS

Soybeans

Field experiments were conducted at the Agronomy Research Station near Perkins, Oklahoma, on a Teller loam soil (Udic Argiustolls) to evaluate the influence of several growth regulators on soybeans. The total precipitation during the soybean growing season (May-November) was 18.9 cm in 1976, and 53.5 cm in 1977. The greatest accumulation of precipitation occurred during the month of May in 1976 (7.5 cm), and 1977 (21.5 cm). Since 1976 was a dry year, sprinkler irrigation was supplied during months when rainfall was below the long-term average. Trifluralin at the rate of 0.6 kg/ha (1976) or butralin at 1.7 kg/ha (1977) (Table I) were applied preplant incorporated for weed control. Hand-hoeings were conducted several times during the growing season to maintain weed-free plots. 'Forrest' cultivar soybeans were inoculated with *Rhizobium japonicum* to insure adequate nodulation, and then planted in 101.6 cm wide rows with a two-row planter at a seeding rate of 56 kg/ha. Growth regulators used are listed in Table I. Treatment stages are listed in Table II. Treatment stages II, III, and IV in 1976, and I, II, and IV in 1977, were applied with an experimental plot tractor sprayer. Treatment stage I in 1976, and III in 1977, were applied with an experimental plot bicycle sprayer. Chemicals were applied in a carrier volume of 374 l/ha on a broadcast equivalent spray

TABLE II

SOYBEAN GROWTH STAGES AT TIME OF TREATMENT

I	II	III	IV
V_4-V_6	R_1	R_2	R_3
4 to 6 nodes	Early Bloom	Full Bloom	Early Pod Formation
20.3 to 30.5 cm tall	8 to 10 nodes	12 to 14 nodes	3 to 4 pods per plant
	35.6 to 45.7 cm tall	45.7 to 61.1 cm tall	66.2 to 81.3 cm tall

volume with a nozzle boom equipped with six hollow cone nozzle tips (TX-12). The boom had two groups of three nozzles arranged by means of a triple swivel body assembly so that the center nozzle sprayed directly downward on the top of the soybean row while the two side nozzles directed the spray at different angles (depending on crop growth stage) to the sides of the soybean plant. By means of extension pipes, the side nozzles extended 25.4 cm to the sides of the row. Cone nozzles were used to aid in getting better coverage of the soybean plants. Plot size was 2 rows by 7.6 m. A randomized complete block design with four replications was employed as the experimental design. Visual observations of discoloration, uniformity, growth inhibition were made at various times after the applications. Ratings were based on a rating scale of 0 to 10, where 0 was equal to no visible crop response and 3 was equal to a 30% response for the stated symptom as compared to the untreated check. A stand count was taken by counting the number of plants in 6.1 m of row. Pod counts were made by randomly selecting 4 plants from 6.1 m of row and counting the number of pod per plant. Visual maturation ratings were made to estimate the number of days before soybean plants were fully mature. Soybeans were harvested upon maturity with a self-propelled small plot combine and seed weights taken.

Peanuts

To evaluate Spanish peanut response to several growth regulators, field experiments were conducted at the Caddo Peanut Research Station, near Ft. Cobb, Oklahoma on a Meno fine sandy loam (Aquic Arenic Haplustalfs). The total precipitation for the peanut growing season

(May-October) was 43.4 cm in 1976, and 67.5 cm in 1977. The greatest accumulation of precipitation occurred during the month of September (12.8 cm) in 1976, and May (42.6 cm) in 1977. Overhead sprinkler irrigation was supplied to maintain good moisture conditions. Trifluralin at 0.56 kg/ha was applied preplant incorporated for weed control. Hand-hoeings were conducted several times during the growing season to keep the plots weed-free. 'Comet' cultivar peanuts were planted in 91.4 cm wide rows at a seeding rate of 112 kg/ha. Growth regulators used are listed in Table I. Treatment stages are listed in Table III. Treatment stages I, III, IV in 1976, and I, III, IV, V, VI and VII in 1977, were applied with experiment plot tractor sprayer. Treatment stages II, V, VI in 1976, and II in 1977, were applied with experimental plot bicycle sprayer. Growth regulators were applied in a carrier volume of 374 l/ha, with a six nozzle boom with hollow cone nozzle tips (TX-12) (specific's about the boom are listed in the methods and materials discussion on soybeans). Plot size for all experiments were 2 rows by 9.1 m. A randomized complete block design with six replications in 1976, and five replications in 1977, was employed as the experimental design. Visual observations were the same as listed in the methods and materials discussion on soybeans. Height and canopy width measurements were made by randomly selecting 4 plants in 7.6 m of row. Peanuts were dug with a commercial digger and allowed to dry in the field for about one week. Peanuts were threshed with a self-propelled threshing machine and in shell peanut weights taken. Unfortunately, at the Caddo Research Station, dug the peanuts incorrectly and yield data could not be obtained during 1976.

TABLE III

SPANISH PEANUT GROWTH STAGES AT FT. COBB AT TIME OF TREATMENT

I	II	III
3-Leaf	5-Leaf	Early Bloom
7.6 to 10.2 cm tall 12.7 to 15.2 cm wide	10.2 to 15.2 cm tall 15.5 to 20.3 cm wide	3 to 4 blooms per plant 15.2 to 20.3 cm tall 20.3 to 25.4 cm wide
IV	**V**	**VI**
Early Pegging	Pegging	Post Bloom
2 to 4 pegs per plant 25.4 to 30.5 cm tall 25.4 to 35.6 cm wide	5 to 7 pegs per plant 30.5 to 35.6 cm tall 38.1 to 50.8 cm wide	10 to 14 pegs per plant 38.1 to 55.9 cm tall Row-closed

Another limited experiment was conducted at the Agronomy Research Station, near Perkins, Oklahoma, on a Teller loam soil (Udis Argiustolls) to evaluate Spanish peanut response to selected growth regulators. The precipitation during the peanut growing season was 18.9 cm in 1976, and 53.5 cm in 1977. The greatest accumulation of precipitation occurred during the month of May in 1976 (7.5 cm), and in 1977 (21.5 cm). Since 1976 was a dry year, sprinkler irrigation was supplied during months when rainfall was below the long-term average. Trifluralin at 0.6 kg/ha (1976) and butralin at 1.7 kg/ha (1977) were applied preplant incorporated for weed control. Hand-hoeings were also conducted to maintain weed-free plots. 'Spanhoma' cultivar Spanish peanuts were planted in 101.6 cm wide rows at the seeding rate of 67.2 kg/ha. Growth regulators used are listed in Table I. Treatment stages are listed in Table IV. Treatment stages I, II, IV, and V in 1976 and II, III, and IV in 1977, were applied with an experimental plot tractor sprayer. All other treatment stages were applied with an experimental plot bicycle sprayer. Plot size for all experiments were 2 rows by 6.1 m. A randomized complete block design with four replications was used as the experimental design. Visual observations were conducted with the same means and methods listed before. Peanuts were dug with a commercial digger, and allowed to dry for about one week. Peanuts were threshed with a small commercial thresher and in shell peanut weights taken.

TABLE IV

SPANISH PEANUT GROWTH STAGES AT PERKINS
AT TIME OF TREATMENT

I	II	III
3-Leaf	5-Leaf	Early Bloom
7.6 to 10.2 cm tall 5.1 to 7.6 cm tall	10.2 to 15.2 cm tall 7.6 to 12.7 cm wide	1 to 3 blooms per plant 17.3 to 22.9 cm tall 15.2 to 17.8 cm wide
IV	V	VI
Early Pegging	Pegging	Post Bloom
2 to 3 pegs per plant 22.9 to 25.4 cm tall 20.3 to 25.4 cm wide	5 to 8 pegs per plant 25.4 to 30.5 cm tall 30.5 to 40.6 cm wide	35.6 to 40.6 cm tall 40.6 to 50.8 cm wide

CHAPTER IV

RESULTS AND DISCUSSION

Soybeans

'Forrest' cultivar soybeans were treated with several growth regulating compounds in the summers of 1976 and 1977. None of the growth regulators utilized in these experiments significantly influenced the number of pods per plant (Tables V, VI, VII, VIII, IX). Cytex treated plants appeared to have larger pods, but seed size or number of seeds per pod did not seem to be altered (Table V). However, pod size measurements were not made. Pod shattering was noticeably decreased with the application of mefluidide (Table VI). It was also noted while harvesting the soybeans that mefluidide treated plants contained more shriveled kernels than did the other treatments. Retention of pods on soybean plants did not seem to be effected by any of the growth regulating compounds used in these studies.

Ethephon and mefluidide caused the greatest degree of visible morphological and physiological changes on soybean plants (Table VII). As the rate of ethephon increased, so did the amount of stunting, at all treatment stages. Reducing ethephon rates by one-half and applying them as two treatments at two stages did not alter the degree of stunting. The greatest amount of stunting occurred at the 2.2 kg/ha rate of ethephon at both treatment stages utilized. Mefluidide caused

TABLE V

EFFECT OF CYTEX ON SOYBEANS

Rate (l/ha)	Treatment Stage	Pod Count (Pods/plant) 1976	Pod Count (Pods/plant) 1977	Stand Count (Plant/ha) 1976	Stand Count (Plant/ha) 1977	Maturation[1/] 1976	Maturation[1/] 1977	Visual Ratings 1976 1[2/]	Visual Ratings 1976 4[2/]	Visual Ratings 1977 1[2/]	Visual Ratings 1977 4[2/]	Yield (kg/ha) 1976	Yield (kg/ha) 1977
1.2	Early Bloom	46	86	15,816	25,016	8	9	0	0	0	0	832	1075
4.7		53	97	12,508	24,209	8	8	0	0	0	0	768	1075
9.4		58	90	11,943	27,840	11	11	0	0	0	0	823	1116
0.6,0.6	Early Bloom,	44	101	13,637	19,770	10	9	1	0	0	0	621	969
2.3,2.3	Full Bloom	66	98	14,525	28,243	9	9	1	0	0	0	887	988
4.7,4.7		46	97	15,171	20,981	8	7	1	0	0	0	622	969
1.2	Full Bloom	42	94	18,560	23,805	8	8	0	0	0	0	595	1062
4.7		53	96	12,992	20,577	10	11	1	0	0	0	668	914
9.4		37	92	19,367	23,805	10	9	1	0	0	0	768	1102
0.6,0.6	Full Bloom,	53	100	14,202	30,261	10	9	1	0	0	0	522	1082
2.3,2.3	Early Pod	39	118	20,254	23,805	7	7	0	0	0	0	540	914
4.7,4.7	Formation	36	94	25,338	27,033	7	7	0	0	0	0	604	1115
Untreated	---	49	80	15,655	22,274	8	9	0	0	0	0	722	1089
LSD 0.10 level		NSD	NSD	6,873	7,866							NSD	NSD
0.05 level		NSD	NSD	8,136	NSD							NSD	NSD
0.01 level		NSD	NSD	NSD	NSD							NSD	NSD
C.V. %		40	35	30	27							30	23

[1/] Estimated days until fully mature.
[2/] Number of weeks after treatment application.

TABLE VI

EFFECT OF MEFLUIDIDE ON SOYBEANS

Rate (kg/ha)	Treatment Stage	Pod Count (Pods/plant)		Stand Count (Plant/ha)		Maturation[1/]		Visual Ratings				Yield (kg/ha)	
								1976		1977			
		1976	1977	1976	1977	1976	1977	1[2/]	4[2/]	1[2/]	4[2/]	1976	1977
0.3	4-6 nodes	--	97	---	27,033	--	10	-	-	1	1	---	907
0.6		--	98	---	23,805	--	9	-	-	1	0	---	995
0.8		--	90	---	26,226	--	10	-	-	2	2	---	968
0.1,0.1	4-6 nodes,	--	72	---	25,823	--	8	-	-	1	1	---	927
0.3,0.3	Early Bloom	--	103	---	26,226	--	9	-	-	1	1	---	1116
0.4,0.4		--	110	---	29,050	--	10	-	-	1	1	---	1122
0.3	Early Bloom	50	99	18,963	22,191	12	13	1	1	0	0	595	739
0.6		40	87	17,591	24,612	12	13	1	1	1	1	503	1021
0.8		46	73	13,718	21,384	11	12	1	1	2	2	603	1075
1.7		55	--	20,012	---	15	--	2	2	-	-	613	---
0.1,0.1	Early Bloom,	49	92	16,381	21,384	14	15	1	1	1	1	668	1015
0.3,0.3	Full Bloom	44	97	20,658	26,226	14	15	1	1	1	2	641	943
0.4,0.4		39	105	18,076	20,174	12	16	1	1	1	2	567	827
0.8,0.8		38	--	19,044	---	13	--	1	2	-	-	749	---
0.3	Full Bloom	38	95	21,303	28,243	12	14	1	1	1	0	759	995
0.6		42	93	18,963	25,823	14	16	1	1	1	1	641	968
0.8		43	100	19,609	23,805	14	18	1	1	2	2	731	1021
1.7		35	--	16,542	---	13	--	2	2	-	-	558	---

TABLE VI (CONTINUED)

Rate (kg/ha)	Treatment Stage	Pod Count (Pods/plant)		Stand Count (Plant/ha)		Maturation[1/]		Visual Ratings				Yield (kg/ha)	
								1976		1977			
		1976	1977	1976	1977	1976	1977	1[2/]	4[2/]	1[2/]	4[2/]	1976	1977
Untreated	---	49	80	15,655	22,274	8	9	0	0	0	0	722	1089
LSD 0.10 level		NSD	NSD	NSD	NSD							NSD	NSD
0.05 level		NSD	NSD	NSD	NSD							NSD	NSD
0.01 level		NSD	NSD	NSD	NSD							NSD	NSD
C.V. %		40	35	30	27							30	23

1/ Estimated days until fully mature.
2/ Number of weeks after treatment application.

TABLE VII

EFFECT OF ETHEPHON ON SOYBEANS

Rate (kg/ha)	Treatment Stage	Pod Count (Pods/plant)		Stand Count (Plant/ha)		Maturation[1/]		Visual Ratings				Yield (kg/ha)	
								1976		1977			
		1976	1977	1976	1977	1976	1977	1[2/]	4[2/]	1[2/]	4[2/]	1976	1977
0.1	Early Bloom	45	104	18,802	22,998	6	5	0	0	0	0	604	954
0.3		34	94	19,447	27,033	10	6	1	0	1	1	485	988
1.1		44	93	16,865	30,664	7	7	1	1	2	2	512	1082
2.2		42	--	15,574	---	9	--	1	2	-	-	641	---
0.1	Full Bloom	47	88	20,416	24,612	6	6	1	0	0	0	522	1183
0.3		54	99	15,978	22,595	8	7	1	0	1	0	786	1492
1.1		50	97	13,637	30,261	7	7	1	1	2	1	521	1082
2.2		63	--	16,462	---	10	--	2	2	-	-	841	---
Untreated	---	49	80	15,655	22,274	8	9	0	0	0	0	722	1089
LSD 0.10 level		NSD	NSD	NSD	7,866							NSD	393
0.05 level		NSD	NSD	NSD	NSD							NSD	NSD
0.01 level		NSD	NSD	NSD	NSD							NSD	NSD
C.V. %		40	35	30	27							30	23

[1/] Estimated days until fully mature.
[2/] Number of weeks after treatment application.

a deeper green, thicker looking leaf at all treatment stages and rates when applied to soybeans. The leaves were retained longer on the plant and displayed a curling of the leaf from the midrib to the leaf margin. The degree of the mefluidide symptoms varied with rate of application, not the treatment stage. The greater the rate of mefluidide the more noticeable the symptom.

Culbac (Table VIII) caused minor visible changes of the soybean plants. A small amount of leaf discoloration was noted at high rates (1.2 and 2.3 l/ha). The leaves appeared to be a deeper green color, but this symptom was not as severe or persistant as with the mefluidide treated plants.

NC-9634 (Table IX) caused a small amount of stunting. This symptom occurred primarily at early treatment stages. The effect of stunting was short-term and it was difficult to distinguish NC-9634 treated plots from untreated plots six weeks after application.

Maturity ratings were made to determine if any of the growth regulators altered maturation of soybean plants. Ethephon seems to show the potential of causing earlier maturity. Some of the ethephon treated plots were mature enough to harvest two to three days before untreated plots. Culbac also showed a minor ability to cause earlier maturity; however, Culbac treated plots were variable and determination of maturity was uncertain. Cytex and NC-9634 did not seem to influence maturity to the same degree as the other treatments. Differences in maturity between the two treatments were not as noticeable as other treatments when compared to untreated soybean plants. Mefluidide caused the greatest degree of maturity differences. The maturity of mefluidide treated plots were delayed seven to ten days. Mefluidide

TABLE VIII

EFFECT OF CULBAC ON SOYBEANS

Rate (l/ha)	Treatment Stage	Pod Count (Pods/plant) 1976	Pod Count (Pods/plant) 1977	Stand Count (Plant/ha) 1976	Stand Count (Plant/ha) 1977	Maturation[1] 1976	Maturation[1] 1977	Visual Ratings 1976 1[2]	Visual Ratings 1976 4[2]	Visual Ratings 1977 1[2]	Visual Ratings 1977 4[2]	Yield (kg/ha) 1976	Yield (kg/ha) 1977
0.3	Early Bloom	42	103	22,675	26,630	7	7	0	1	0	0	814	995
0.6		38	98	17,753	24,209	8	7	1	1	0	0	586	914
1.2		36	87	19,851	21,384	5	6	0	1	0	0	544	914
2.3		46	89	22,595	24,289	8	9	1	1	1	0	942	1116
0.2,0.2	Early Bloom,	46	89	16,220	25,823	7	8	1	1	0	0	806	995
0.3,0.3	Full Bloom	40	89	19,044	19,770	6	5	1	1	0	0	851	948
0.6,0.6		44	98	12,992	17,753	6	7	1	1	0	0	586	800
1.2,1.2		37	82	16,058	24,209	7	7	1	1	0	0	786	914
0.3	Full Bloom	38	105	22,433	26,226	8	7	1	0	0	0	841	995
0.6		50	78	18,640	24,612	9	8	0	0	0	0	796	927
1.2		39	105	21,303	26,630	7	7	0	0	0	0	759	1001
2.3		37	79	18,479	33,489	6	7	0	0	0	0	613	1089
0.2,0.2	Full Bloom,	42	89	19,447	21,788	5	6	1	0	-	0	750	1015
0.3,0.3	Early Pod	43	88	16,946	20,981	6	8	0	0	-	0	768	907
0.6,0.6	Formation	50	82	20,819	29,454	10	10	1	0	-	0	777	1062
1.2,1.2		47	92	15,332	22,998	10	11	0	0	-	0	832	943

TABLE VIII (CONTINUED)

Rate (l/ha)	Treatment Stage	Pod Count (Pods/plant) 1976	Pod Count (Pods/plant) 1977	Stand Count (Plant/ha) 1976	Stand Count (Plant/ha) 1977	Maturation[1/] 1976	Maturation[1/] 1977	Visual Ratings 1976 1[2/]	Visual Ratings 1976 4[2/]	Visual Ratings 1977 1[2/]	Visual Ratings 1977 4[2/]	Yield (kg/ha) 1976	Yield (kg/ha) 1977
Untreated	---	49	80	15,655	22,274	8	9	0	0	0	0	722	1089
LSD 0.10 level		NSD	NSD	6,873	7,866							NSD	NSD
0.05 level		NSD	NSD	NSD	8,941							NSD	NSD
0.01 level		NSD	NSD	NSD	NSD							NSD	NSD
C.V. %		40	35	30	27							30	23

[1/]Estimated days until fully mature.
[2/]Number of weeks after treatment application.

TABLE IX

EFFECT OF NC-9634 ON SOYBEANS

Rate (kg/ha)	Treatment Stage	Pod Count (Pods/plant)		Stand Count (Plant/ha)		Maturation[1/]		Visual Ratings				Yield (kg/ha)	
								1976		1977			
		1976	1977	1976	1977	1976	1977	1[2/]	4[2/]	1[2/]	4[2/]	1976	1977
0.1	4-6 nodes	--	60	---	18,560	--	7	-	-	1	1	---	759
0.3		--	103	---	25,019	--	9	-	-	1	0	---	934
0.6		--	74	---	23,001	--	9	-	-	1	1	---	914
0.1,0.1	4-6 nodes,	59	69	15,332	27,037	12	10	1	1	0	0	613	927
0.2,0.2	Early Bloom	44	78	18,479	24,211	11	11	1	0	1	0	668	1021
0.3,0.3		38	92	16,139	29,055	12	11	1	0	1	0	604	1082
0.1	Early Bloom	36	87	15,574	29,457	8	7	1	0	0	0	741	1001
0.3		62	111	11,781	19,772	11	10	1	0	0	0	696	1035
0.6		43	114	15,978	19,930	9	7	1	0	0	0	741	827
Untreated	---	49	80	15,655	22,274	8	9	0	0	0	0	722	1089
LSD 0.10 level		NSD	NSD	NSD	NSD							NSD	NSD
0.05 level		NSD	NSD	NSD	NSD							NSD	NSD
0.01 level		NSD	NSD	NSD	NSD							NSD	NSD
C.V. %		40	35	30	27							30	23

1/ Estimated days until fully mature.

2/ Number of weeks after treatment application.

also caused delayed leaf drop. Leaves of mefluidide treated soybean plants dropped about one week after untreated plants.

Since 1976 was such a dry year, yield responses are less than 1977. Ethephon at 0.3 kg/ha when applied at the full bloom stage of growth caused the only yield increase. This was in the 1977 growing season, and growing conditions were much better that year. Soybeans appeared to be the most responsive to yield when treated with ethephon during the full bloom stage. Cytex seemed to be the only other growth regulator which had the potential of increasing yields. Although none of the Cytex treated plots significantly increased yield, most were similar to or above the yield of untreated plots. The greatest response with Cytex was from early bloom stage treatments. None of the other growth regulators altered the yield.

The Forrest cultivar soybeans utilized in these experiments did not demonstrate a serious problem of lodging. However, it was noted that after a serious thunderstorm in August of 1977 the ethephon treated plots were more erect than other plots. Other authors have expressed the idea of lodge-reducing possibilities with ethephon usage (9).

Blem et al. (7) noted a greater yield response to Forrest soybeans than Davis when treated with NC-9634. More research is needed with NC-9634 and other growth regulators on different varieties of soybeans. Other experiments should also be conducted on irrigated soybeans to determine the effects of growth regulators grown under better growing conditions than those exhibited in these experiments. With more usage of a narrower row-spacing than employed in these experiments (101.6 cm), research is needed to determine if growth regulators have any effect on soybeans grown in different row spacing. Since meat-analogs are becoming more prominent on the market perhaps research should be conducted on the quality of soybeans treated with growth regulators.

Irrigated Peanuts

Irrigated 'Comet' cultivar Spanish peanuts were treated with growth regulators during the summers of 1976 and 1977. All of the growth regulators utilized displayed some visible response depending on specific compound, rate, and stage of crop growth. Ethephon (Table X) caused slight chlorosis of peanut plants at all treatment stages, but only at higher rates (1.1 and 2.2 kg/ha). However, the symptom was short-lived and was not noticeable two weeks after application. Leaf margins of plants treated with mefluidide (Table XI) tended to curl upward. The symptom was more noticeable at early treatment stages the at higher rates (0.8 and 1.7 kg/ha). Within a three week period mefluidide treated plants did not display the leaf-curl symptom. Both Culbac (Table XII) and SADH (Table XIII) caused a darker green coloration of leaves. However, only the SADH treated plants retained the dark green coloration of the leaf throughout the entire growing season. Other symptoms characteristic of SADH treated peanut plants include (a) a more compact and robust looking plant (b) leaves seemed to be thicker (c) and shorter internode length especially at the base of the plant. Only a slight degree of stunting was seen with Cytex (Table XIV) treated plots. The stunting caused by the application of Cytex was not consistant throughout all replications and determination of the degree of stunting was difficult. At early treatment stages Cytex treated

TABLE X

EFFECT OF ETHEPHON ON IRRIGATED SPANISH PEANUTS

Rate (kg/ha)	Treatment Stage	Visual Ratings 1976		Visual Ratings 1977		Plant Height (cm)		Canopy Width (cm)		Yield (kg/ha)
		1[1]	6[1]	1[1]	6[1]	1976	1977	1976	1977	
0.1	3-leaf	0	0	0	0	38	51	79	81	3090
0.3		0	0	0	0	41	49	79	77	3171
1.1		1	0	1	0	38	51	74	79	3138
2.2		1	1	1	0	45	50	89	85	3058
0.1	5-leaf	0	0	0	0	41	49	80	77	3323
0.3		0	0	0	0	39	49	76	74	2988
1.1		1	0	1	0	41	49	76	75	2727
2.2		1	0	1	0	39	51	78	80	2970
0.1	Early Bloom	0	0	0	0	39	49	78	77	3073
0.3		0	0	0	0	40	49	81	76	3025
1.1		0	0	0	0	37	51	80	78	3226
2.2		1	0	1	0	37	51	80	79	2840
0.1,0.1	Early Bloom,	0	0	-	-	42	--	79	--	---
0.2,0.2	Early Pegging	0	0	-	-	37	--	73	--	---
0.6,0.6		0	0	-	-	37	--	76	--	---
1.1,1.1		0	1	-	-	36	--	76	--	---
0.1	Early Pegging	0	0	0	0	42	53	83	86	3388
0.3		0	0	0	0	37	50	74	77	3123

TABLE X (CONTINUED)

Rate (kg/ha)	Treatment Stage	Visual Ratings 1976		Visual Ratings 1977		Plant Height (cm)		Canopy Width (cm)		Yield (kg/ha)
		1[1/]	6[1/]	1[1/]	6[1/]	1976	1977	1976	1977	
1.1	Early Pegging	0	0	0	0	38	50	72	80	2699
2.2		1	0	1	0	38	49	71	80	2895
0.1,0.1	Early Pegging, Pegging	0	0	0	0	41	47	79	78	3144
0.2,0.2		0	0	0	0	42	49	82	77	2649
0.6,0.6		0	0	0	0	40	50	74	74	2943
1.1,1.1		0	0	0	0	41	50	82	87	2654
0.1	Pegging	0	0	0	0	38	49	75	79	3264
0.3		0	0	0	0	41	51	77	72	3182
1.1		0	0	0	0	40	49	76	76	3339
2.2		0	0	0	0	43	45	83	76	2852
0.1,0.1	Pegging, Post Bloom	0	-	0	-	38	--	76	--	3209
0.2,0.2		0	-	0	-	41	--	76	--	3426
0.6,0.6		0	-	0	-	44	--	80	--	3090
1.1,1.1		0	-	0	-	39	--	77	--	3176
Untreated	---	0	0	0	0	42	47	76	77	3415
LSD 0.10 level						4	4	8	7	NSD
0.05 level						5	5	9	8	NSD
0.01 level						NSD	6	12	NSD	NSD
C.V. %						12	8	11	9	18

[1/]Number of weeks after treatment application.

TABLE XI

EFFECT OF MEFLUIDIDE ON IRRIGATED SPANISH PEANUTS

Rate (kg/ha)	Treatment Stage	Visual Ratings 1976		Visual Ratings 1977		Plant Height (cm)		Canopy Width (cm)		Yield (kg/ha)
		1[1/]	6[1/]	1[1/]	6[1/]	1976	1977	1976	1977	
0.3	Early Bloom	0	0	0	0	41	47	81	77	3215
0.6		0	0	0	0	40	50	75	78	3003
0.8		1	0	0	0	38	48	73	74	3437
1.7		1	0	-	-	40	--	74	--	---
0.1,0.1	Early Bloom, Early Pegging	0	0	0	0	41	50	77	72	2955
0.3,0.3		0	1	1	0	38	50	76	77	2672
0.4,0.4		0	1	0	0	38	47	76	75	2770
0.8,0.8		1	1	-	-	40	--	77	--	---
0.3	Early Pegging	0	0	0	0	40	46	79	74	3166
0.6		0	0	0	0	38	48	71	77	3329
0.8		0	0	1	0	43	49	81	75	2548
1.7		0	1	-	-	39	--	77	--	---
0.1,0.1	Early Pegging, Pegging	0	0	0	0	40	49	75	72	2960
0.3,0.3		0	0	0	0	41	46	79	76	2840
0.4,0.4		0	0	1	0	40	45	78	75	3128
0.8,0.8		0	0	-	-	42	--	79	--	---
0.3	Pegging	0	0	0	0	42	45	81	74	2714
0.6		0	0	0	0	40	48	80	75	2932

TABLE XI (CONTINUED)

Rate (kg/ha)	Treatment Stage	Visual Ratings 1976		Visual Ratings 1977		Plant Height (cm)		Canopy Width (cm)		Yield (kg/ha)
		1[1]	6[1]	1[1]	6[1]	1976	1977	1976	1977	
0.8	Pegging	0	0	0	0	42	48	82	80	2852
1.7		1	0	-	-	40	--	81	--	---
Untreated	---	0	0	0	0	42	47	76	77	3415
LSD 0.10 level						NSD	NSD	NSD	NSD	775
0.05 level						NSD	NSD	NSD	NSD	NSD
0.01 level						NSD	NSD	NSD	NSD	NSD
C.V. %						12	8	11	9	18

[1] Number of weeks after treatment application.

TABLE XII

EFFECT OF CULBAC ON IRRIGATED SPANISH PEANUTS

Rate (l/ha)	Treatment Stage	Visual Ratings 1976		Visual Ratings 1977		Plant Height (cm)		Canopy Width (cm)		Yield (kg/ha)
		1[1/]	6[1/]	1[1/]	6[1/]	1976	1977	1976	1977	
0.3	5-leaf	0	0	0	0	40	50	81	77	3166
0.6		0	0	0	0	40	51	77	76	3236
1.2		0	0	0	0	38	50	76	79	3220
0.2	Early Pegging	0	0	0	0	38	49	74	77	3394
0.6		0	0	0	0	40	49	75	77	3415
1.2		0	0	0	0	40	49	82	81	3138
2.3		1	0	0	0	39	48	79	79	2835
0.2,0.2	Early Pegging, Pegging	0	0	0	0	38	--	74	--	3279
0.3,0.3		0	0	0	0	41	--	76	--	3241
0.6,0.6		1	0	0	0	43	--	84	--	3193
1.2,1.2		1	0	0	0	42	--	80	--	2770
0.3	Pegging	0	-	0	-	41	--	84	--	3502
0.6		0	-	0	-	41	--	81	--	3754
1.2		0	-	0	-	41	--	79	--	3754
2.3		0	-	0	-	42	--	82	--	3226
0.2,0.2	Pegging, Post Bloom	0	-	0	-	40	--	75	--	3420
0.3,0.3		0	-	0	-	44	--	81	--	3306
0.6,0.6		0	-	0	-	43	--	77	--	3241
1.2,1.2		0	-	0	-	40	--	79	--	3231

TABLE XII (CONTINUED)

Rate (l/ha)	Treatment Stage	Visual Ratings 1976 1[1/]	6[1/]	1977 1[1/]	6[1/]	Plant Height (cm) 1976	1977	Canopy Width (cm) 1976	1977	Yield (kg/ha)
Untreated	---	0	0	0	0	42	47	76	77	3415
LSD 0.10						NSD	NSD	8	NSD	NSD
0.05						NSD	NSD	NSD	NSD	NSD
0.01						NSD	NSD	NSD	NSD	NSD
C.V. %						12	8	11	9	18

[1/] Number of weeks after treatment application.

TABLE XIII

EFFECT OF SADH ON IRRIGATED SPANISH PEANUTS

Rate (kg/ha)	Treatment Stage	Visual Ratings 1976 1[1/]	Visual Ratings 1976 6[1/]	Visual Ratings 1977 1[1/]	Visual Ratings 1977 6[1/]	Plant Height (cm) 1976	Plant Height (cm) 1977	Canopy Width (cm) 1976	Canopy Width (cm) 1977	Yield (kg/ha)
1.1	Early Bloom	2	2	-	-	38	--	67	--	---
2.2		3	2	-	-	37	--	61	--	---
0.6,0.6	Early Bloom,	1	2	-	-	37	--	63	--	---
1.1,1.1	Early Pegging	2	3	-	-	34	--	65	--	---
1.1	Early Pegging	1	1	2	1	38	40	71	69	2570
2.2		2	2	3	2	39	37	71	64	2981
0.6,0.6	Early Pegging,	1	1	2	1	38	40	71	69	2570
1.1,1.1	Pegging	1	1	1	2	36	35	74	65	2686
1.1	Pegging	1	1	1	1	39	44	75	71	2716
2.2		2	1	2	2	42	42	76	69	2672
Untreated	---	0	0	0	0	42	47	76	77	3415
LSD 0.10 level						4	4	8	7	775
0.05 level						5	5	9	8	NSD
0.01 level						7	6	12	11	NSD
C.V. %						12	8	11	9	18

[1/] Number of weeks after treatment application.

TABLE XIV

EFFECT OF CYTEX ON IRRIGATED SPANISH PEANUTS

Rate (l/ha)	Treatment Stage	Visual Ratings 1976 1[1/]	Visual Ratings 1976 6[1/]	Visual Ratings 1977 1[1/]	Visual Ratings 1977 6[1/]	Plant Height (cm) 1976	Plant Height (cm) 1977	Canopy Width (cm) 1976	Canopy Width (cm) 1977	Yield (kg/ha)
1.2	Early Pegging	0	0	0	0	41	49	77	76	2895
4.7		0	0	0	0	40	47	78	77	3149
9.4		1	0	0	0	42	49	80	75	3084
0.6,0.6	Early Pegging, Pegging	0	0	0	0	40	--	72	--	2965
2.3,2.3		1	0	0	0	43	--	84	--	2895
4.7,4.7		1	0	0	0	41	--	82	--	3382
1.2	Pegging	0	-	0	-	42	--	78	--	3265
4.7		1	-	0	-	41	--	80	--	3329
9.4		1	-	0	-	40	--	78	--	3193
0.6,0.6	Pegging, Post Bloom	0	-	0	-	39	--	77	--	3199
2.3,2.3		0	-	0	-	38	--	75	--	3220
4.7,4.7		0	-	0	-	38	--	76	--	2754
Untreated	---	0	0	0	0	42	47	76	77	3415
LSD 0.10 level						NSD	NSD	8	NSD	NSD
0.05 level						NSD	NSD	NSD	NSD	NSD
0.01 level						NSD	NSD	NSD	NSD	NSD
C.V. %						12	8	11	9	18

[1/] Number of weeks after treatment application.

plants were bushier and internode length was noticeably longer towards the base of the plant. The pod size of Cytex treated peanut plants seemed to be larger than other treated or nontreated plants. NC-9634 (Table XV) when applied at 3.4 kg/ha to peanut plants having 2 to 4 pegs/plant caused similar symptoms as SADH treated plants.

To determine the effect of growth regulators on plant growth, height and canopy width measurements were made. Both Culbac and ethephon displayed the potential of increasing the size of peanut plants. Culbac significantly increased the canopy width. Rows among Culbac and ethephon treated plots seemed to close earlier than other treated and nontreated rows and determination of canopy width was difficult. None of the ethephon treatments decreased plant growth, which differs from reports by others (55,56). NC-9634, and SADH both caused a significant reduction in plant height, and canopy width. NC-9634 applied at 3.4 kg/ha to peanuts having 2 to 4 pegs/plant caused 11% and 13% reductions in plant height and canopy width, respectively. The growth regulator showing the greatest potential of reducing peanut plant size was SADH. Plant height was reduced 8 cm (19%) and 12 cm (26%) below the untreated check in 1976 and 1977, respectively. The application of SADH to peanut plants caused canopy width reductions of 15 cm (20%) and 13 cm (17%) below the untreated check in 1976 and 1977, respectively. The degree of plant size reduction displayed by SADH is comparable to reports of several other authors (11,21,56).

None of the growth regulators evaluated in these experiments increased the yield of irrigated peanuts. Although yield increases with NC-9634 and Culbac were not significant, they were the only

TABLE XV

EFFECT OF NC-9634 ON IRRIGATED SPANISH PEANUTS

Rate (kg/ha)	Treatment Stage	Visual Ratings 1976		Visual Ratings 1977		Plant Height (cm)		Canopy Width (cm)		Yield (kg/ha)
		1[1/]	6[1/]	1[1/]	6[1/]	1976	1977	1976	1977	
0.03	Early Bloom	-	-	0	0	--	49	--	75	3420
0.1		0	0	-	-	40	--	75	--	---
0.3		0	0	0	0	38	49	75	80	3437
0.6		1	0	-	-	40	--	79	--	---
1.1		1	0	1	0	37	50	76	77	3610
3.4		-	-	1	1	--	48	--	77	3415
0.1,0.1	Early Bloom, Pegging	0	0	0	0	39	48	76	75	3388
0.2,0.2		0	0	-	-	37	--	74	--	---
0.3,0.3		0	0	-	-	41	--	79	--	---
0.6,0.6		1	0	-	-	39	--	77	--	---
1.1,1.1		-	-	1	1	--	42	--	69	3573
0.1	Early Pegging	0	0	0	0	40	46	77	77	3152
0.3		0	0	0	0	42	46	80	75	2989
0.6		0	0	-	-	38	--	74	--	---
1.1		0	0	-	-	41	--	83	--	---
3.4		-	-	2	2	--	42	--	67	3356
0.1,0.1	Early Pegging, Pegging	0	0	-	-	41	--	81	--	---
0.2,0.2		0	0	-	-	41	--	81	--	---
0.3,0.3		0	0	-	-	38	--	74	--	---
0.6,0.6		0	0	-	-	37	--	75	--	---

TABLE XV (CONTINUED)

Rate (kg/ha)	Treatment Stage	Visual Ratings 1976 1[1/]	1976 6[1/]	1977 1[1/]	1977 6[1/]	Plant Height (cm) 1976	Plant Height (cm) 1977	Canopy Width (cm) 1976	Canopy Width (cm) 1977	Yield (kg/ha)
0.1	Pegging	0	0	-	-	39	--	80	--	---
0.3		0	0	-	-	39	--	73	--	---
0.6		0	0	-	-	38	--	75	--	---
1.1		0	0	-	-	41	--	78	--	---
Untreated	---	0	0	0	0	42	47	76	77	3415
LSD 0.10 level						NSD	4	NSD	7	NSD
0.05 level						NSD	NSD	NSD	8	NSD
0.01 level						NSD	NSD	NSD	NSD	NSD
C.V. %						12	8	11	9	18

[1/] Number of weeks after treatment application.

treatments which displayed the potential to increase yield. Mefluidide and SADH caused yield decreases. Mefluidide applied at 0.8 kg/ha to peanut plants having 2 to 4 pegs/plant decreased yields 867 kg/ha. SADH applied to peanuts at 0.6 kg/ha at both 2 to 4 pegs/plant and 8 to 10 pegs/plant and 1.1 kg/ha at 2 to 4 pegs/plant decreased yields 845 kg/ha. The decrease in yield displayed by SADH agrees with other authors (18,43).

Nonirrigated Peanuts

Spanhoma Spanish peanuts grown under nonirrigated conditions were treated with growth regulators. Visible responses displayed by growth regulators were not as noticeable as they were with irrigated peanuts. Ethephon (Table XVI) caused minor foliar chlorosis, but it did not persist to the same extent as in irrigated peanuts. SADH (Table XVII) suppressed the growth of plants throughout the entire growing season. It was difficult to determine whether the leaf-curl caused by mefluidide (Table XVIII) was caused by the dry climatic conditions or the treatment. Culbac (Table XIX) treated plants did not display the deeper green coloration of normal peanut leaves.

Culbac was the only growth regulator which caused a yield increase. An application of 0.3 l/ha of Culbac at the 2 to 3 pegs/plant stage caused an increase in yield of 889 kg/ha. The greatest amount of yield decline (556 kg/ha) was mefluidide applied at 0.8 kg/ha to plants having 2 to 4 blooms. However, ethephon and SADH also reduced peanut yields, 519 kg/ha and 446 kg/ha, respectively.

Other observations noted were that under very dry climatic conditions, SADH treated plants did not display the same degree of

TABLE XVI

EFFECT OF ETHEPHON ON NONIRRIGATED SPANISH PEANUTS

Rate (kg/ha)	Treatment Stage	Visual Ratings 1976 1[1/]	1976 4[1/]	1977 1[1/]	1977 4[1/]	Yield (kg/ha) 1976	Yield (kg/ha) 1977
0.1	3-leaf	0	0	0	0	2258	1885
0.3		0	0	0	0	2350	1774
1.1		1	1	0	1	1939	1640
0.1	5-leaf	0	0	0	0	2048	1950
0.3		0	0	0	1	1920	1785
1.1		0	1	0	1	1939	1730
2.2		1	1	-	-	2075	---
0.1	Early Bloom	0	0	0	0	2093	1840
0.3		0	0	0	0	1957	1987
1.1		1	0	1	0	1975	1646
2.2		1	0	-	-	1682	---
0.1,0.1	Early Bloom, Early Pegging	0	0	-	-	1884	---
0.2,0.2		0	0	-	-	1939	---
0.6,0.6		1	0	-	-	1728	---
1.1,1.1		1	1	-	-	1381	---
0.1	Early Pegging	0	0	1	0	2029	1822
0.3		0	0	1	0	1994	1822
1.1		1	0	1	0	1875	1603
2.2		1	1	-	-	1975	---
0.1,0.1	Early Pegging, Pegging	0	0	0	0	2103	1774
0.2,0.2		0	0	0	0	1746	1658
0.6,0.6		1	0	1	1	1865	1712
1.1,1.1		1	1	-	-	1627	---
0.1	Pegging	0	0	0	0	1719	1621
0.3		0	0	0	0	1829	1658
1.1		1	0	1	0	1719	1993
2.2		1	1	0	0	1719	---

TABLE XVI (CONTINUED)

Rate (kg/ha)	Treatment Stage	Visual Ratings 1976 1[1/]	4[1/]	1977 1[1/]	4[1/]	Yield (kg/ha) 1976	1977
0.1,0.1	Pegging,	0	0	-	-	2057	---
0.2,0.2	Post Bloom	0	0	-	-	2295	---
0.6,0.6		0	0	-	-	2029	---
1.1,1.1		0	0	-	-	1765	---
Untreated	---	0	0	0	0	2036	2122
LSD 0.10 level						463	237
0.05 level						548	280
0.01 level						NSD	369
C.V. %						21	13

[1/]Number of weeks after application.

TABLE XVII

EFFECT OF SADH ON NONIRRIGATED SPANISH PEANUTS

Rate (kg/ha)	Treatment Stage	Visual Ratings 1976 1[1/]	4[1/]	1977 1[1/]	4[1/]	Yield (kg/ha) 1976	1977
1.1	Early Bloom	1	2	-	-	1975	----
2.2		2	2	-	-	2642	----
0.6,0.6	Early Bloom,	0	1	-	-	2468	----
1.1,1.1	Early Pegging	1	1	-	-	2139	----
1.1	Early Pegging	1	2	1	2	2460	1676
2.2		2	2	2	3	2268	2005
0.6,0.6	Early Pegging,	1	2	1	2	2295	1774
1.1,1.1	Pegging	2	3	2	2	1985	1774
1.1	Pegging	1	1	1	1	2121	1719
2.2		2	1	2	1	1902	1749
Untreated	---	0	0	0	0	2036	2122
LSD 0.10 level						463	237
0.05 level						548	280
0.01 level						NSD	369
C.V. %						21	13

[1/]Number of weeks after application.

TABLE XVIII

EFFECT OF MEFLUIDIDE ON NONIRRIGATED SPANISH PEANUTS

Rate (kg/ha)	Treatment Stage	Visual Rating 1976 1[1/]	Visual Rating 1976 4[1/]	Visual Rating 1977 1[1/]	Visual Rating 1977 4[1/]	Yield (kg/ha) 1976	Yield (kg/ha) 1977
0.3	Early Bloom	0	0	0	1	2038	1848
0.6		0	0	0	0	2004	1719
0.8		1	0	1	1	1783	1566
1.7		1	1	-	-	2012	---
0.1,0.1	Early Bloom, Early Pegging	0	0	0	0	2268	1640
0.3,0.3		0	0	0	0	2139	1785
0.4,0.4		0	0	0	0	2004	1640
0.8,0.8		0	1	-	-	1994	---
0.3	Early Pegging	0	0	0	0	1865	1785
0.6		0	0	1	0	1820	1756
0.8		1	0	1	0	1829	1774
1.7		1	0	-	-	1491	---
0.1,0.1	Early Pegging, Pegging	0	0	0	0	1967	1701
0.3,0.3		0	0	0	0	1673	1880
0.4,0.4		0	0	0	0	1673	1767
0.8,0.8		1	0	-	-	1783	---
0.3	Pegging	0	0	0	0	1399	1976
0.6		0	0	0	0	1975	1914
0.8		0	0	0	0	1700	1712
1.7		1	0	-	-	1645	---
Untreated	---	0	0	0	0	2036	2122
LSD 0.10 level						463	237
0.05 level						548	280
0.01 level						NSD	369
C.V. %						21	13

[1/]Number of weeks after treatment application.

TABLE XIX

EFFECT OF CULBAC ON NONIRRIGATED SPANISH PEANUTS

Rate (l/ha)	Treatment Stage	Visual Ratings 1976 1[1/]	4[1/]	1977 1[1/]	4[1/]	Yield (kg/ha) 1976	1977
0.3	5-leaf	0	0	0	0	2606	1940
0.6		0	0	1	0	2569	2031
1.2		1	0	0	0	2213	2042
2.3		1	0	1	0	2496	2122
0.3	Early Pegging	0	0	-	-	2925	---
0.6		0	0	-	-	2477	---
1.2		0	0	-	-	2158	---
2.3		1	0	-	-	2268	---
0.2,0.2	Early Pegging, Pegging	0	0	-	-	2496	---
0.3,0.3		0	0	-	-	2304	---
0.6,0.6		0	0	-	-	2523	---
1.2,1.2		0	0	-	-	1875	---
0.3	Pegging	0	0	0	0	1875	1903
0.6		0	0	0	0	2387	1859
1.2		0	0	0	0	2194	1995
2.3		1	0	0	0	2240	2024
0.2,0.2	Pegging, Post Bloom	0	0	-	-	2158	---
0.3,0.3		0	0	-	-	2167	---
0.6,0.6		0	0	-	-	2185	---
1.2,1.2		0	0	-	-	2167	---
Untreated	---	0	0	0	0	2036	2122
LSD 0.10 level						463	237
0.05 level						548	NSD
0.01 level						720	NSD
C.V. %						21	13

[1/] Number of weeks after treatment application.

wilting as untreated plants. Since yield increases were not obtained by the application of SADH, it is doubtful that SADH has the potential to be utilized as a promoter of drought tolerance in peanuts. Ethephon treated plants remained green longer and did not dry as quickly after digging as other treated or untreated plants. This caused a problem in threshing. Pods on ethephon treated plants were more difficult to remove. This was probably a factor in the yield reduction in yield caused by ethephon.

The erratic responses both visual and with yields seem to be related to environmental conditions as well as growth regulators. Other authors have reported similar erratic responses by applying growth regulators to Spanish peanuts (12,18,43,56,57). More research should be conducted with growth regulators on other varieties of Spanish and Florunner-type peanuts. Row-spacing might also play an important role in the utilization of growth regulators. Several authors (10,43) have conducted research with SADH on peanuts grown in different row-spacings, however, more research is needed with other growth regulators applied to peanuts grown in different row-spacings. Better quality peanuts are of greater value on the market. Perhaps growth regulators can improve the quality of Spanish and Florunner-type peanuts. One factor which might be investigated is the cost benefit of treating peanut plants with SADH to compare the cost of ground applications to aerial applications of pesticides later in the growing season.

CHAPTER V

SUMMARY AND CONCLUSIONS

The influence of several plant growth regulators on soybeans and Spanish peanuts were examined in the field. Visible responses such as alteration of normal growth, coloration differentiation, and maturity were evaluated on soybeans. Visible responses to growth regulators such as degree of stunting and color variation were evaluated on irrigated and nonirrigated Spanish peanuts. Plant height and canopy width measurements were made on irrigated peanuts. Yield evaluations were analyzed on soybeans, irrigated and nonirrigated peanuts.

The commercial use of the growth regulators utilized in these experiments do not seem feasible on soybeans. However, mefluidide did show the potential of delaying maturity of soybeans. The shattering of soybean pods was also decreased by the application of mefluidide. If a large farming operation was undertaken with large acreages of soybeans, mefluidide might have some potential agricultural use. If the cultivar of soybeans in question had a tendency to shatter pods before harvest was completed, an application of mefluidide earlier might aid in reducing the degree of pod shattering before the plants were able to be harvested.

Since ethephon showed some potential to increase soybean yield more research should be conducted. Perhaps ethephon could be applied at different rates or treatment stages and under better environmental conditions than those environmental conditions that occurred in these studies to determine if ethephon can consistantly increase yields.

Environmental conditions seem to be more attributable to the erratic responses obtained by growth regulator applications than other factors, such as rate of treatment or crop growth at time of treatment. Different varieties of soybeans may also play a key role in soybean response to growth regulators. Therefore, experiments with the use of growth regulators should also be conducted in soybean plants which are supplied with sufficient amounts of water. Research on other cultivars, either earlier or later maturing than Forrest, or perhaps other determinate or indeterminate-type soybeans, should also be conducted.

SADH and NC-9634 reduced plant height and canopy width of peanut plants. Both growth regulators demonstrated a greater potential to decrease plant growth than did other treatments. However, SADH caused yield decreases, whereas no yield responses were obtained with NC-9634. A reduced growth in peanut plants does have some commercial potential. Pesticide applications to peanuts which are recommended in late July and August are primarily aerial applied. If plant growth was suppressed enough to allow a ground application of pesticides, this might save the farmer the cost of aerial application over ground application. Cultivation might also be possible later in the growing season, which could aid in the control of weeds and perhaps prevent yield losses due to weed infestations. Smaller plants mean less wear and tear on peanut harvesting equipment.

None of the growth regulators utilized seem to alter yield enough to make them feasible for commercial use. However, other responses might be of some agricultural use and more research is needed. Research on the use of these and other growth regulators should be conducted to determine the quality of nuts, such as increased protein content, peanut oil, etc. Experiments with growth regulators in combination with different pesticides to determine what, if any, interaction might develop. The effect of growth regulators on other Spanish-type and Florunner-type peanuts should also be examined.

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VITA 2

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Master of Science

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