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Table 1. Treatments used in field study.

Treatment No.	Common name or abbreviation	Chemical structure
1	IAA	3-indole acetic acid
2	Gibrel	gibrellic acid
3	Kinetin	6-furfurylamino purine
4	NAA	1-naphthyleneacetic acid
5	MeNAA	2-methyl-1-naphthylene acetic acid
6	NAAm	1-napthyleneacetamide
7	MeNAAm	2-methyl-napthyleneaceticamide
8	Napthoxy	beta napthoxy acetic acid
9	NaMeAct	alpha naphthyl methyl acetate
10	Succinic acid	Succinic acid
11	TD-692	Pennsalt designation, chemistry confidential
12	TD-693	Pennsalt designation, chemistry confidential
13	TD-6056	Pennsalt designation, chemistry confidential
14	TD-6058	Pennsalt designation, chemistry confidential
15	Omaflora	beta hydroxyethyl hydrazine
16	Alar	N-dimethyl amino succinamic acid
17	Hadacidin	N-hydroxy-N-formyl sodium glycinate
18	Duraset	N-m-tolylphthalamic acid
19	IBA	indole butyric acid
20	MeMe	1-napthylmethyl methyl ether
21	Butoxy	Buthoxy ethyl ester of NAA
22	MH	maleic acid hydrazide
23	TIBA	2,2,5-triiodo benzoic acid
24	Tetra CBA	2,3,5,6-tetrachloro-benzoic acid
25	Mendock	sodium alpha-beta-dichloroisobutyrate

EFFECTS OF GROWTH REGULATORS ON GERMINATING COTTON

By G. E. COATS[1]

The following report gives the results of a screening program at Stoneville on the effects of various growth regulators on germinating cotton. Studies were primarily limited to laboratory studies with follow-up work in the field in spring of 1967 and limited studies in controlled environment chambers.

Effects of growth regulators on germinating seed were studied using the bioassay for vigor described by Christiansen[2]. In each study 25 seed were placed on germinating paper with the radicle end of the seed aligned in one direction. Each germination roll was wet with water or a water solution containing growth regulators. Rolls were placed in a rack in an upright position in the germinator at constant 68 degrees F for 7 days.

After 7 days 5 seedlings were removed from each roll, the cotyledons separated from the root-hypocotyl, and the dry weight of each determined; and subsequently, the conversion of cotyledonary reserves to the root hypocotyl was determined. This percent conversion was used as the measure of seedlings growth.

Each test in this study was a randomized block with treatments of 0, 0.01, 0.1, 1.0, 10.0 and 100.0 ppm and 5 replications. Each test was conducted at least twice. Growth regulators through 18 listed in Table 1 were included in this study.

Field studies conducted in the spring of 1967 included the growth regulators used above, plus those listed in Table 1 including combinations of 3 of these growth regulators. Seed were treated in the laboratory in quantities of 100 grams as seed overcoat.

Growth regulators at 2 rates (0.005 and 0.05 oz cwt) were combined with 10 oz cwt of 65% 1,4-dichloro-2,5-dimethoxybenzene (Demosan) and 2 pt. cwt 2.89% methylmercury 2,3-dihydroxy propyl mercaptide and .62% methylmercury acetate (Ceresan L).

On April 13 seed were planted at Stoneville using a belt planter with 100 seed per 24 row feet. Di-Syston (10% formulation o-o - dimethyl S-2 (ethylthio) ethyl phosphorodi thioate) was applied through the hill-drop unit (20-inch hills) at the rate of 4.2 pounds per acre. Stand counts were made the last week in May and the first week in June.

Growth regulators which had shown possible stimulation under germinator conditions were used in growth chamber studies at 0.005 and 0.05 oz cwt. These included Duraset, Gibrel, and MeNAAm. The 4 growth regulators appearing in the Pennington Green Coat seed treatment were also included in this study. Five seed were planted in cups in Bosket sandy loam soil.

Plants remained in the growth chamber for 7-10 days after emergence and then were moved to the greenhouse for an additional week. At this time dry weight of above ground parts of plants was determined. Conditions in the chamber were set at 80% relative humidity, 76° F day temperature and 65° F night temperature with a 16-hour day.

The response of germinating cotton to growth regulators varied from possible stimulation to no apparent effect to inhibition of growth. In most cases, treat-

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[2]Crop Science 3:487-489.

Table 2. The effect of several natural and synthetic growth regulating compounds on the germination and vigor of germinating Stoneville 213 cotton.

Growth regulator	Treatment	% Germination	Root-hypocotyl		
			Dry wt-mg	Length-cm	% Total
IAA	0	84	257.8 a*	6.3 ab*	23.6 ab*
	0.01	84	259.8 a	7.1 a	25.4 a
	0.1	80	248.2 a	6.7 ab	23.7 ab
	1.0	75	221.8 ab	5.9 ab	22.4 b
	10.0	84	253.6 a	5.6 b	23.0 ab
	100.0	80	189.8 b	2.1 c	17.5 c
Gibrel	0	96	391.2	9.9 ab*	32.4 a*
	0.01	96	405.4	9.4 a	34.1 ab
	0.1	94	407.0	9.5 a	33.5 ab
	1.0	95	410.8	10.5 ab	34.5 ab
	10.0	98	414.8	11.1	35.4 b
	100.0	96	407.6	9.6 ab	35.3 b
Kinetin	0	99	348.2 ab*	7.4 ab*	28.6 ab*
	0.01	98	370.2 a	8.0 a	29.6 a
	0.1	96	349.2 ab	7.6 b	28.4 ab
	1.0	99	329.0 bc	7.1 b	27.1 bc
	10.0	97	306.6 cd	6.0 c	25.2 cd
	100.0	93	274.4 d	4.6 d	24.1 d
NAA	0	75	166.8 a*	2.82 a*	15.4 ab*
	0.01	75	173.6 a	3.00 a	16.7 a
	0.1	80	142.0 a	2.76 ab	14.5 ab
	1.0	80	143.4 a	2.06 b	14.9 ab
	10.0	75	130.8 ab	1.30 c	12.7 bc
	100.0	65	90.6 b	.68 c	10.1 c
MeNAA	0	96	348.6 a*	8.8 a*	30.7 a*
	0.01	98	372.4 b	8.2 a	30.1 a
	0.1	94	366.4 b	8.2 a	30.2 a
	1.0	95	357.6 b	7.7 a	30.0 a
	10.0	98	290.0 c	4.1 b	24.3 b
	100.0	94	249.4 d	2.4 b	21.1 c
MeNa Acetamide	0	98	307.4 a c**	7.7 ab**	25.6 a
	0.01	97	323.8 ab	8.0 a c	27.1 a
	0.1	96	334.4 b	7.9 bc	27.3 a
	1.0	98	328.2 b	8.2 c	27.2 a
	10.0	99	323.2 ab	7.6 b	27.2 a
	100.0	94	293.8 c	5.6 d	24.6 a

See footnotes at end of table

Table 2. The effect of several natural and synthetic growth regulating compounds on the germination and vigor of germinating Stoneville 213 cotton--Continued.

Growth regulator	Treatment	% Germination	Root-hypocotyl Dry wt-mg	Root-hypocotyl Length-cm	Root-hypocotyl % Total
Napthozy acetic	0	94	374.6	10.4 a	31.1 a
	0.01	90	348.4 ab	9.2 a	29.8 a
	0.1	98	368.6 a	10.1 a	30.5 a
	1.0	94	331.8 bc	7.3 b	27.9 a
	10.0	94	316.8 c	4.1 c	27.0 a
	100.0	94	214.0 d	1.2 d	18.3 b
NAAm	0	99	313.0 a***	6.5 a*	26.4 a*
	0.01	99	319.6 a	7.0 a	26.5 a
	0.1	98	305.6 ab	6.4 a	25.4 ab
	1.0	98	301.6 ab	6.6 a	26.6 a
	10.0	100	304.2 ab	6.1 a	24.1 bc
	100.0	99	277.0 b	4.0 a	22.8 c
NAMeAct	0	94	362.8 a	8.6 a	30.0 a
	0.01	98	368.6 a	8.6 a	30.0 a
	0.1	96	358.6 a	7.9 b	29.7 a
	1.0	97	340.2 b	5.8 c	28.1 a
	10.0	98	292.4 c	3.0 d	24.6 b
	100.0	96	128.4 d	0.6 e	10.6 c
Succinic Acid	0	84	271.0	7.7	25.5
	0.01	80	260.0	7.2	24.7
	0.1	76	245.0	6.5	24.7
	1.0	76	249.0	6.6	24.0
	10.0	76	250.0	6.1	24.8
	100.0	80	264.0	6.7	24.4
TD-692	0	96	322.2	8.40 ab*	28.5
	0.01	96	327.0	8.82 a	28.8
	0.1	96	300.8	7.30 bc	27.2
	1.0	96	316.4	8.36 ab	28.9
	10.0	92	326.2	8.38 ab	28.9
	100.0	92	304.0	7.00 c	27.0
TD-693	0	96	240.1	6.5	22.5
	0.01	92	238.2	6.1	21.6
	0.1	96	232.2	5.5	21.5
	1.0	96	244.6	7.2	22.4
	10.0	96	246.4	6.3	22.4
	100.0	92	246.6	5.6	22.3

See footnotes at end of table

Table 2. The effect of several natural and synthetic growth regulating compounds on the germination and vigor of germinating Stoneville 213 cotton--Continued.

Growth regulator	Treatment	% Germination	Root-hypocotyl		
			Dry wt-mg	Length-cm	% Total
TD-6056	0	92	328.0 a**	8.9	29.1
	0.01	92	307.0 b	7.9	28.2
	0.1	96	307.0 b	8.0	28.1
	1.0	92	211.0 ab	8.7	28.4
	10.0	92	297.0 b	8.1	24.8
	100.0	96	312.0 ab	9.0	27.0
TD-6058	0	92	299.4	7.3	25.4
	0.01	96	287.0	7.6	26.0
	0.1	92	287.6	6.7	25.4
	1.0	92	296.6	7.4	26.6
	10.0	96	277.4	7.6	26.4
	100.0	92	281.6	6.8	25.1
Omaflora	0	72	237.0	7.6 ab***	24.2
	0.01	88	259.0	7.1 ab	24.2
	0.1	80	260.0	7.2 ab	24.5
	1.0	80	258.0	6.8 bc	25.6
	10.0	84	282.0	7.8 a	25.6
	100.0	75	239.0	6.2 c	23.2
Alar	0	92	282.6	7.14 a**	25.3
	0.01	96	286.4	7.08 a	25.3
	0.1	92	282.2	7.00 a	25.3
	1.0	96	287.4	7.08 a	25.4
	10.0	96	283.4	7.26 a	25.4
	100.0	92	269.0	5.88 b	23.9
Hadacidin	0	80	235.0	5.4 ab**	23.2
	0.01	80	275.0	7.1 a	25.0
	0.1	80	250.0	6.0 ab	25.5
	1.0	84	257.0	6.3 a	24.4
	10.0	75	260.0	7.0 a	25.9
	100.0	75	221.0	4.2 b	21.3
Duraset	0	89	329.8 a*	7.7 a**	28.1 a**
	0.01	93	339.0 ab	8.1 a	28.1 a
	0.1	95	356.2 ab	9.5 b	30.5 b
	1.0	94	367.4 b	9.4 b	30.3 b
	10.0	92	355.8 ab	8.9 ab	29.7 ab
	100.0	88	334.8 a	7.6 a	28.3 a

*, **, *** Values having a common letter do not differ significantly according to Duncan's Multiple Range Test at the 1% (*), 5%(**), or 10%(***) level.

Table 3. Effect of growth regulators and combinations of growth regulators in combination with Demosan and Ceresan on stand of Stoneville 213 cotton.

Treatment No.	Growth regulator	Rate 1/ oz-cwt	Stand count
21	Butoxy	0.005	65.6
	Butoxy	0.05	56.8
22	MH	0.005	55.2
	MH	0.05	58.0
10	Succinic Acid	0.005	49.8
	Succinic Acid	0.05	57.8
11	TD-692	0.005	50.4
	TD-692	0.05	56.2
0	Fungicide only	0	50.8
12	TD-693	0.005	51.6
	TD-693	0.05	63.6
13	TD-6056	0.005	54.0
	TD-6056	0.05	59.8
14	TD-6058	0.005	57.8
	TD-6058	0.05	53.4
15	Omaflora	0.005	54.6
	Omaflora	0.05	53.4
16	Alar	0.005	43.8
	Alar	0.05	56.6
0	Fungicide only	0	47.2
17	Hadacidin	0.005	52.6
	Hadacidin	0.05	47.2
23	TIBA	0.005	44.4
	TIBA	0.05	41.2
24	Tetra CBA	0.005	43.0
	Tetra CBA	0.05	41.4
25	Mendock	0.005	44.8
	Mendock	0.05	48.6
19	IBA	0.005	37.4
	IBA	0.05	40.6
LSD .05			13.0
LSD .01			17.2

1/ Applies to each chemical where combinations were used.

ments of higher rates tended to inhibit growth. Only one growth regulator, Duraset, under laboratory conditions consistently stimulated growth. Gibrel which has been extensively tested on cotton and a large number of other plants stimulated growth, but not consistently.

The three naturally occurring growth regulators IAA, Gibrel, and Kinetin in general caused no significant effect at lower rates. However, with the exception of Gibrel, growth as measured by the dry weight of root - hypocotyl, length of the root-hypocotyl, and the percent conversion to the root - hypocotyl tended to be progressively inhibited as concentration increased.

In the field sudy, there was particu-

Table 4. Effect of growth regulators on early growth of cotton under controlled environmental conditions.

Treatment		% Germination	Dry wt-mg per plant
Chemical	Oz-cwt		
Demosan + Ceresan	0	87	312
Demosan + Ceresan + gibrel	0.005	82	333
Demosan + Ceresan + duraset		85	325
Demosan + Ceresan + MeNAAm		78	307
Demosan + Ceresan + gibrel	0.05	78	298
Demosan + Ceresan + duraset		84	270
Demosan + Ceresan + MeNAAm		78	310
Demosan + Ceresan + NAA + MeNAA + NAAm + IBA	0.005	73	326
Demosan + Ceresan + NAA + MeNAA + NAAm + IBA	0.05	71	315

lar interest in the survival of cotton under early spring weather conditions, especially low temperature. As it turned out, we had probably one of the worst cool and wet springs seen in the Mississippi Delta in the past few years.

Again in this test as in the germinator test, the results indicated no consistent beneficial response of growth regulators including Duraset.

The only significant change in stand counts was a reduction in stands in which combinations of the high rates of Gibrel, Duraset, and MeNAAm were used. It should be pointed out that in the case of double treatment, seed received twice the amount of growth regulator and 3 times as much in combinations of 3. It is also interesting to note that in each case of a reduction, one of the regulators was Gibrel. The combination of Duraset and MeNAAm at the higher rate did not significantly reduce stand counts.

Growth chamber studies indicated no significant increase in growth from Gibrel, Duraset, MeNAAm or NAA and derivatives plus IBA. In two tests conducted in the growth chamber, data indicated partial reductions in stand of seed treated with NAA + MeNAA + MeNAAm + IBA. These are 4 growth regulators which are included in the Pennington Green Coat seed treatment.

CONCLUSIONS

This study has not revealed any growth regulator which would find practical application under field conditions. It should be pointed out that response similar to Duraset is applicable only under the specific conditions under which tests of this kind are conducted.