Influence of 2,3,5-Triiodobenzoic Acid and Gibberellin on Growth, Yield and Nutrient Content of Southern Peas[1]

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Abstract. Field experiments were conducted to determine the influence of TIBA and Gibberellin sprays on yield, growth characteristics and chemical composition of 'California Blackeye No. 5' and 'Purple Hull Pinkeye' varieties of southern peas. Yield of peas was slightly increased on both varieties with the application of TIBA. Time of application as well as rate was a critical factor in producing maximum yields. Application of TIBA reduced plant size and concentrated maturity. The application of 50 ppm Gibberellin 5 days after application of 20 g per acre of TIBA further concentrated maturity and increased the desirability of peas for mechanical harvest. Iron concentrations in pea leaves were increased with application of TIBA.

Introduction

The use of triiodobenzoic acid (TIBA) on soybeans has received a considerable amount of attention in recent years although its effects on soybeans were characterized by Galston (3) as early as 1947. Greer and Anderson (4) studied response of soybeans to TIBA and noted a change from the vegetative stage to reproductive stage as well as a change in leaf orientation and decreased size of plants at maturity. Yield of seed was also increased by the application of TIBA to the plants. Burton and Curley (1) observed similar results on soybeans in that application of TIBA reduced plant height and increased branching but did not increase yield unless additional N was applied. Wax and Pendleton (7) obtained similar results but narrow row spacings were required to obtain yield increases from applications of TIBA. Prevatt and Lundy (6) indicated that southern peas showed a response similar to that of soybeans when treated with TIBA.

One of the limiting factors in the production of southern peas is the high cost of harvesting. Data obtained from experiments with TIBA on soybeans and peas indicate that the use of the chemical on southern peas might make them more adaptable to mechanical harvest as well as increase yields. To evaluate this hypothesis, experiments were conducted in 1967 and 1968 at the Texas A&M University Agricultural Research and Extension Center at Weslaco.

Materials and Methods

Experiments were conducted in 1967 on Willacy fine sandy loam soil and on Hidalgo sandy clay loam in 1968. The experimental area was fertilized preplant with 40-80-0 in 1967; in 1968, 40-80-0 and 2½ lb. iron chelate and 2½ lb. zinc chelate per acre (A) was applied preplant. The experimental designs were not the same for all experiments but were either Latin squares or randomized blocks with 4 replications except the 'California Blackeye No. 5' in the spring of 1967 was not replicated. Plots were 25 ft long with 3 rows per plot. Plants were grown on 38 inch beds. Two varieties of peas were used, 'California Blackeye No. 5' ('Blackeye') at about 39,000 plants/A and 'Purple Hull Pinkeye' ('Purple Hull') at about 52,000 plants/A. Yield data were obtained from the center row of each plot. The experiments in the spring of 1967 consisted of TIBA rates of 0, 5, 10, 20, 30, 40 and 50 g/A applied to the plants as a spray in 20 gal/A of water. Polyoxyethylene sorbitan monolaurate surfactant was used at a concentration of 500 ppm with all treatments. Gibberellin (Ethylene Glycol Monobutyl Ether Gibberellate[4]) was also applied at 250 ppm (20 gal/A) 3 days after TIBA treatments of 20 and 50 g/A. Experiments were conducted with 5 rates of TIBA on 'California Blackeye No. 5' peas in the fall of 1967 but yield data were not obtained because of Hurricane Beulah. Leaves for chemical analyses were obtained, however, from the plants about 10 days prior to maturity of the peas. The 4th leaf from the growing terminal was obtained (20 leaves/plot) for analyses. The leaves were dry ashed as outlined by Chapman and Pratt (2). Cation determinations were made by atomic absorption and P was determined by the molybdate-blue method.

Experiments in the spring of 1968 consisted of TIBA rates of 0, 5, 10, 20 and 40 g/A applied at 3, 4, 5 and 6 weeks after emergence on both varieties. In a separate experiment TIBA treatments of 20 g/A at 4½ weeks after emergence were applied and Gibberellin treatments of 50 and 100 ppm were applied 5 days later. The same procedure for taking yield data and leaf samples was used in 1968 as in 1967. Plant height measurements were made in 3 locations of each treatment and replication by measuring to the top of the plant canopy.

Table 1. Influence of TIBA on yield of southern peas, Spring 1967.

TIBA/A (g)	Shelled peas/A (lb.)	
	California Blackeye No. 5[x]	Purple Hull Pinkeye
0	1204	1874 a[y]
5	2235	1800 a
10	1719	1536 c
20	1204	1726 ab
30	1465	1603 bc
40	1203	1339 d
50	1163	1229 d

[x]This variety was not replicated in the spring of 1967.
[y]Means in a column having different letters beside them differ at the 0.05 level of significance.

Results and Discussion

TIBA. The influence of TIBA on yield of shelled peas in the spring of 1967 is shown in Table 1. There was a tendency toward increased yield with the 5 and 10 g rate of TIBA on 'Blackeye' but very little effect on yield was noted at higher rates. The results

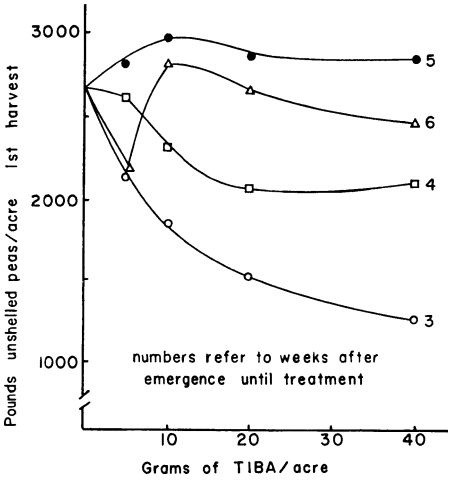

Fig. 1. Influence of time and rate of application of TIBA on yield of 'California Blackeye No. 5' peas.

[1]Received for publication December 18, 1968.

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[3]Appreciation is expressed to International Minerals and Chemical Corporation, Skokie, Illinois, for partial support of the research.

[4]Plant growth regulator manufactured by Merck Industrial Products Division, Merck & Co., Inc., Rahway, New Jersey, under the name Gibrelate.

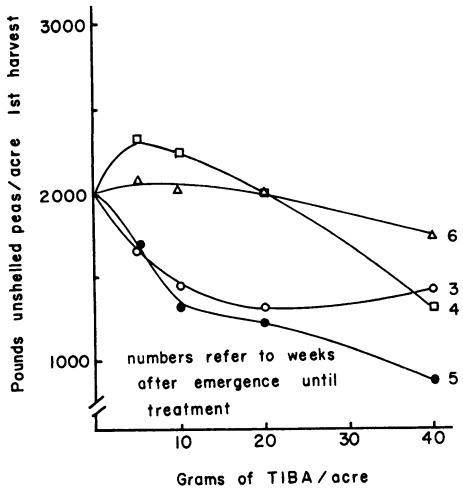

Fig. 2. Influence of time and rate of application of TIBA on yield of 'Purple Hull Pinkeye' peas.

of TIBA on the 'Purple Hull' showed a decrease in yield with all rates of TIBA but yields were not drastically reduced until the concentration of TIBA reached 40 g/A. These results indicate a varietal interaction between TIBA and southern peas.

In the 1968 rate and time of application experiment the data also show a variety difference in response to TIBA treatment. The maximum increase in yields on 'Blackeye' (Fig. 1) was obtained with the 10 g rate applied 5 weeks after emergence of the peas (just prior to bloom). The increase in yield was significant at the 0.10 level of significance but not at the 0.05 level. When applied at 3 or 4 weeks after emergence there was a decrease in yields (0.10 level) at all rates of TIBA except the 5 g at 4 weeks treatment. The reason for the sharp decrease in yield of 'Blackeye' with the 5 g rate at 6 weeks was not apparent from the data. The highest yields obtained with 'Purple Hull'

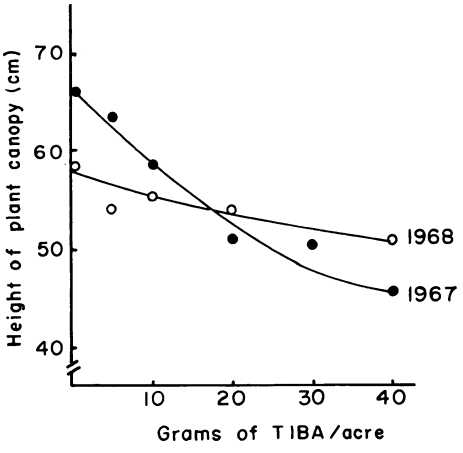

Fig. 3. Influence of TIBA on height of plant canopy of 'Purple Hull Pinkeye' (1967) and 'California Blackeye No. 5' peas (1968).

Table 2. Influence of TIBA on nutrient concentration in 'Blackeye' pea leaves.[x]

TIBA/A (g)	% P		ppm Fe		ppm Zn		ppm Mn		% Ca		% Mg		% K	
	1967	1968	1967	1968	1967	1968	1967	1968	1967	1968	1967	1968	1967	1968
0	0.39a	0.23	222a	195a	31a	59	220	380	2.22a	4.36	0.52	0.64	2.00	1.98
5	0.39a	0.23	224a	176a	31a	53	208	355	2.28a	4.20	0.52	0.64	1.97	1.90
10	0.38a	0.25	262b	180a	38b	60	213	303	2.45a	3.70	0.51	0.58	1.96	2.16
20	0.48b	0.20	260b	255b	36b	51	186	361	2.08b	3.83	0.52	0.65	2.09	2.35
40	0.43b	0.24	270b	240b	39b	64	197	403	1.94b	4.29	0.51	0.66	2.22	2.30

[x]Means in a column not having the same letter beside them differ at the .05 level of significance. Columns without letters indicate no differences.

was at the 5 g rate applied 4 weeks after emergence (Fig. 2). The increase was significantly higher at the 0.05 level. The 3 and 5 week application date significantly reduced yields (0.05 level) at all rates but when treated at 6 weeks there was little influence on yield.

The influence of TIBA on height of the plants at maturity indicates a reduction in plant size on both varieties (Fig. 3). In 1967, height of

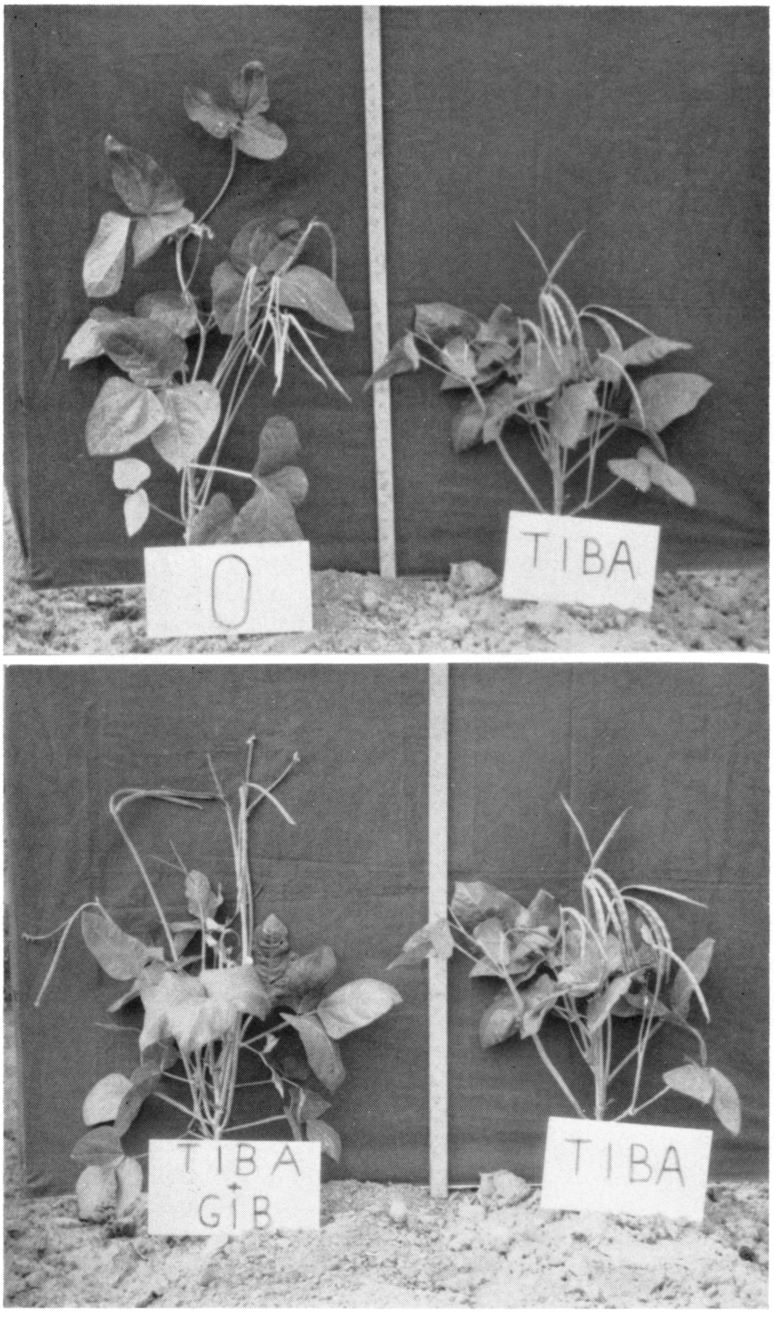

Fig. 4. Influence of TIBA and Gibberellin on growth of 'California Blackeye No. 5' peas.

'Purple Hull' was reduced from 66 cm to about 46 cm with the 40 g rate of TIBA applied 5 weeks after emergence. In 1968 'Blackeye' height was reduced from 58 cm to 51 cm with the 40 g treatment applied 5 weeks after emergence.

The nutrient concentrations in 'Blackeye' pea plants as influenced by TIBA are shown in Table 2. The peas were grown in the fall of 1967 and spring of 1968 on different soil types so direct comparison of the values cannot be made, however, trends may be observed. The nutrient concentration in leaves was not generally influenced by TIBA until the treatment was 10 g/A or more. The most noteworthy trend indicated in Table 2 is the concentration of Fe in leaves for both years. The 10, 20 and 40 g treatments in 1967 and 20 and 40 g treatments in 1968 resulted in a higher concentration of Fe in the leaves. Kessler and Moscicki (5) suggested that TIBA aids in mobilization of Fe within the plant. The increase in Fe mobilization and concentration in the leaves offers a partial explanation for the dark green color associated with TIBA treated plants. Phosphorus, Zn and Ca concentrations were influenced by TIBA treatment in 1967 but not in 1968.

TIBA-Gibberellin. TIBA application results in reduced vegetative growth whereas Gibberellin is noted for its influence on elongation or inter-node lengthening of plants. It appears feasible that a pea plant desirable for mechanical harvesting might be obtained by applying TIBA to reduce growth then later applying Gibberellin to elongate the plant to raise the pea pods above the plant. Indeed, experiments in 1967 and 1968 proved this to be so in that peas were elongated above the plant canopy (Fig. 4). Although there was not an increase in yield with the application of Gibberellin, a more desirable plant was produced. Faster maturity was observed when TIBA-Gibberellin treatments were applied. Table 3 shows that about 70% of the peas were picked at the first harvest on the check plots while 82 and 86% were harvested on the TIBA and TIBA-Gibberellin plots, respectively. This would be a definite advantage in mechanical harvesting since the first harvest or once-over harvest is of primary importance. On 'Blackeye' in 1968 the most desirable combination of plant size, geometry and yield was obtained with 20 g/A of TIBA applied 4½ weeks after emergence with 50 ppm Gibberellin applied 5 days later. In 1967 50 g/A of TIBA with 250 ppm Gibberellin applied 3 days later had similar effects.

Table 3. Influence of TIBA – Gibberellin combinations on growth and yield of 'Blackeye' peas.

Treatment	1968 1st harvest[a]	1968 2nd harvest	1968 Total yield	1968 Plant width (cm)	1968 Plant ht (cm)
Check	1488[b]	612	2100	47.7	54.5
20 g/A TIBA	1115	240	1355	41.2	51.0
50 ppm Gibberellin	1320	620	1940	48.0	53.2
100 ppm Gibberellin	1325	710	2035	48.2	54.0
20 gm TIBA + 50 ppm Gibberellin	1189	198	1387	39.0	47.5
20 gm TIBA + 100 ppm Gibberellin	1280	280	1560	39.5	47.8
		1967 Once-over harvest[c]			
20 g/A TIBA + 250 ppm Gibberellin		949			
50 g/A TIBA + 250 ppm Gibberellin		1238			
Check		1204			

[a]Shelled peas in lb/A.
[b]Yields at first harvest were not significantly different at 0.05 level.
[c]Yields of once-over harvest were not significantly different at 0.05 level.

Quantitative Inheritance of Ten Root Traits in Sweetpotatoes[1]

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Abstract. A parent-offspring study of 40 sweetpotato lines grown in 6 environments provided heritability (%) estimates for 10 root characters as follow: weight, 41; number edible roots, 32; veining, 30; growth cracks, 51; flesh oxidation, 64; shape, 62; flesh color, 66; cortex thickness, 45; skin color, 81; and skin purpling, 74. In most cases the realized changes due to selection fit the predictions very well. The additive component of genetic variance was relatively more important than the non-additive for all traits except veining and number of edible roots. The study illustrates the usefulness of quantitative genetic approaches to sweetpotato breeding.

Introduction

Genetic study of the sweetpotato, *Ipomoea batatas* (L.) Lam., a hexaploid, has been limited by problems commonly associated with genetic studies of polyploids compounded by infrequent flowering and low seed set. The recent development of a randomly intermating population has provided improved flowering and seed production necessary for a parent-offspring quantitative genetic study of the species (2). Preliminary morphological observations of this population have indicated its value for genetic studies. Cytological observations of sweetpotato (1) show bivalent pairing of chromosomes during meiosis to be the rule, and unpublished qualitative genetic studies indicate that many character segregations can be explained on the basis of multiple factor disomic models. Thus, quantitative genetic theories, although formulated for use with diploids, may be applicable to sweetpotatoes.

[1]Received for publication December 18, 1968. Journal Series Paper No. 398. University of Georgia College of Agriculture Experiment Stations, Coastal Plain Station, Tifton, Georgia.

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[5]The authors are indebted to E. J. Koch, Biometrician, U. S. Department of Agriculture, for assistance with the statistical analysis of data.

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