Selected Growth Regulators Increase Yield of Snap Beans[1]

Raymond E. Campbell[2] and J. K. Greig[3]
Kansas State University, Manhattan

Abstract. **A single foliar spray of 5-chloro,-2-thenyl,tri-n-butyl-phosphonium chloride (CTBP), 90% soluble powder; tetrahydrofurfuryl isothiocyanate (CHE 8570), 47% emulsifiable concentrate; 5-bromo,2-thenyl,tributyl-ammonium chloride (CHE 9064), 50% wettable powder; or 2,3,5-triiodobenzoic acid (TIBA), 14.2% emulsifiable concentrate, was applied when first flowers opened of 'Salem' and 'Top Crop' snap beans (*Phaseolus vulgaris* L.). Treatments of CHE 9064 at 8.72 g/ha and TIBA at 2.32 g/ha significantly increased yield of spring-planted 'Salem' in 1971. Treatments of CHE 8570 and CHE 9064 at 11.62 g/ha significantly increased yields of spring-planted 'Top Crop' in 1972 due to increased pod set. Foliage samples at harvest showed no physiologically significant increase in P, K, Ca, Mg, Fe, or Zn for the treated plants compared with the controls.**

Several workers have used growth-regulating substances, with various degrees of success, to increase snap bean yields. Fisher et al. (3), who increased yields of field-grown beans 16 to 18% by applying d-naphthaleneacetic acid and p-chlorophenoxyacetic acid to prevent blossom abscission, reported that at maturity the pods were superior to untreated pods. In another study (4), yields were increased 59 to 72% by treating plants with naphthaleneacetamide and naphthoxyacetic acid. These increases were highest during hot, dry weather, generally considered not favorable for bean production. Wort (6, 7) reported that 2,4-dichlorophenoxyacetic acid applied at nonherbicidal levels with a nutrient dust resulted in a 23 to 40% increase in pod yield of 'Top Crop' and 'Masterpiece' and that naphthenates increased yield by 20% because of increased pod size. Fattah and Wort (2) found that naphthenate-treated plants grew larger and produced more pods at high than at low temp and light intensities. Tompkins et al. (5) found that CTBP increased pod set and hence yields of late-summer and late-spring planted beans.

In 1971 and 1972, we tested three new growth substances[4], CTBP, 90% soluble powder; CHE 8570, 47% emulsifiable concentrate; CHE 9064, 50% wettable powder; and one well known material, TIBA, 14.2% emulsifiable concentrate, each applied on spring and fall crops of 'Salem' and 'Top Crop' snap beans to determine their ability to increase yeilds of beans grown for processing.

Planting, treatment, and harvesting dates for the two cultivars used are indicated in Table 1. A randomized block design was used for each planting with treatments replicated four times. Single-row plots were 6.1 m. long; plants in the middle 3.1 m. were harvested. Plant spacing was 2.5 cm. in the row and 91.4 cm. between rows. The growth regulators were applied using an "Air-Plot" sprayer, 211 g/sq.cm. (30 psi), delivery pressure at 1.24 km per hr, when the first flowers opened. Normal cultural practices such as fertilizing, irrigating, and controlling pests were maintained throughout the growing season.

The beans were harvested when the majority of pods in the control plots were sieve size 5 (.95-1.07 cm diam), a desirable size for processing. All pods were harvested to simulate a once-over mechanical harvest for field trials 1 and 2. Field trial 3 was harvested twice, 7 days apart, and both yields were combined for the total yield. Two harvests were necessary due to environmental conditions at pod set severely reducing the yield of the first harvest. Total yields and wt of 100 pod samples taken randomly from each treatment were recorded to determine if yield differences resulted from differences in pod set or size. In field trial 3, the pod sample wt was the average of the 2 harvests.

Immediately after harvest, trifolialate leaf samples were taken from the harvested area and dried to constant wt in a forced air oven at 65°C. The samples then were ground in a Wiley mill. A 0.5 g sample of the ground plant material was wet digested and anlyzed for P, K, Ca, Mg, Fe, and Zn content, using an atomic absorption spectrophotometer (1).

In field trial 1, all treatments except CTBP at 34.86 g/ha and 69.72 g/ha increased yields of 'Salem' over that of the control. However, CHE 9064 at 8.72 g/ha and TIBA at 2.32 g/ha were the only 2 treatments producing yields significant at the 5% level (Table 2).

In field trial 2, all treatments increased yields over the control, but these were not statistically significant. Maximum air temp ranged from 30-33°C. during an 11 day period after treatment of field trial 2. The plants were in full bloom at this time and many of the flowers abscissed due to high temp. There was only 0.59 cm of normal rainfall during the entire growth period.

Eight of the 11 treatments in field trial 3 increased yield of 'Top Crop' over that of the control (Table 2) but only CHE 9064 and CHE 8570, both at 11.62 g/ha, produced yields significantly greater at the 5% level. Those treatments that were significantly higher yielding than the control were not significantly heavier by pod sample wt. None of the treatments that produced yields significantly less than the control had pod wt significantly less than the control (Table 2). Since each treatment was harvested when the majority of pods in the control plants were sieve size 5, it was concluded that differences in yield were due to differences in pod set rather than differences in pod size. Also, none of the treatments significantly affected the uptake of P, K, Ca, Mg, Fe, or Zn consistently when compared with the control. This indicates that treatments increased yield without decreasing dilution of nutrient content.

Three or 4 days after treating plants with 34.86 or 69.72 g/ha of CTBP, we observed marginal chlorosis on the young foliage in field trial 1. The chlorosis disappeared, however, as the leaves expanded and was not observed on the plants subsequently. Within 2 days after treatment in all studies, those plants treated with TIBA showed slight curling of the trifoliate leaves. The curling became more severe when the

[4]Chemagro Chemical Corporation provided materials and some financial support.

[1]Contribution No. 525, Department of Horticulture and Forestry, Kansas Agricultural Experiment Station, Kansas State University, Manhattan 66506.

[2]Present address: Department of Horticulture, Virginia Polytechnic Institute and State University, Blacksburg, Virginia.

[3]Vegetable Crop Researcher.

Table 1. Planting, treatment, and harvesting dates of beans.

Field trial	Cultivar	Planting date	Treatment date	Harvest date
1	Salem	May 5, 1971	June 4, 1971	June 28, 1971
2	Salem	Aug. 5, 1971	Sept. 1, 1971	Sept. 23, 1971
3	Top Crop	May 4, 1972	June 21, 1972	July 5, 1972

Table 2. Snap bean yields and pod-sample wt as influenced by 4 growth regulators, 1971 and 1972.

Trial, season and cultivar	Growth regulator	Treatment rate (g/ha)	Yield (MT/ha)	Weight 100 pod sample (g)
Field trial 1, *Spring, 1971—cv. Salem:*				
	CTBP	11.62	.61bcd[z]	494.2ab[z]
		34.86	.53d	511.0a
		69.72	.57cd	444.2e
	CHE 8570	11.62	.63bcd	457.5de
		34.86	.66bcd	462.7cde
		69.72	.71bc	476.5bcd
	CHE 9064	2.91	.65bcd	486.7abc
		8.72	.87a	495.0ab
		17.43	.61bcd	484.2bc
	TIBA	1.16	.62bcd	491.5ab
		2.32	.76ab	496.7ab
	Control	0	.58cd	477.2bcd
Field trial 2, *Fall, 1971—cv. Salem:*				
	CTBP	11.62	.60ab	315.5bc
		34.86	.50ab	328.5bc
		69.72	.61ab	288.7cd
	CHE 8570	11.62	.65ab	335.5bc
		34.86	.51ab	328.7bc
		69.72	.44ab	319.0bc
	CHE 9064	2.91	.59ab	432.0a
		8.72	.41ab	370.0b
		17.43	.48ab	362.2b
	TIBA	1.16	.60ab	366.2b
		2.32	.47ab	554.5b
	Control	0	.33b	260.2d
Field trial 3, *Spring, 1972—cv. Top Crop:*				
	CTBP	5.81	1.69bc	259.0c
		11.62	1.85abc	303.2abc
		23.24	1.87abc	280.2bc
	CHE 8570	11.62	2.32a	359.2ab
		23.24	2.07abc	370.7a
		46.48	1.79abc	258.7c
	CHE 9064	2.91	1.54c	282.0bc
		5.81	1.59c	312.7abc
		11.62	2.38a	313.7abc
	TIBA	2.91	1.51c	327.0abc
		5.81	2.11abc	286.7abc
	Control	0	1.68bc	317.7abc

[z]Mean separation in columns for a given field trial by Duncan's multiple range test, 5% level.

concn of the chemical was increased. In field trial 3, those plants receiving TIBA at a concn of 5.81 g/ha showed severe signs of epinasty, and at harvest the pods were twisted or curled. TIBA treated plants were shorter than non-treated and had thicker and darker green leaves.

We concluded that these materials offer potential for increasing snap bean yields. The materials used should be investigated further, however, to determine the interaction between cultivars and seasonal variations.

Literature Cited

1. Asif, Mir I., and J. K. Greig. 1972. Effects of seasonal interactions of nitrogen, phosphorous, and potassium fertilizer on yield and nutrient content of snap beans, (*Phaseolus vulgaris* L.). *J. Amer. Soc. Hort. Sci.* 97:44-47.
2. Fattah, Q. A., and D. J. Wort. 1970. Effect of light and temperature on stimulation of vegetative and reproductive growth of bean plants by naphthenates. *Agron. J.* 62:576-577.
3. Fisher, E. H., A. J. Riker, and T. C. Allen. 1946. Bud, blossom, and pod drop of canning string beans reduced by plant hormones. *Phytopathology* 36:504.
4. Murneek, A. E., S. H. Wittwer, and D. D. Hemphill. 1944. "Hormone" sprays for snap beans. *Proc. Amer. Soc. Hort. Sci.* 44:428-432.
5. Tompkins, D. R., W. A. Sistrunk, and J. W. Fleming. 1971. Yield of snap beans (*Phaseolus vulgaris* L.) as influenced by 5-chloro, 2-thenyl, tri-n-butyl-phosphonium chloride. *HortScience* 6:393-394.
6. Wort, D. J., 1966. Effect of 2,4-D nutrient dusts on the growth and yield of beans and sugar beets. *Agron. J.* 58:27-29.
7. ———. 1969. Stimulation of vegetative and reproductive growth of bush bean plants by naphthenates. *Can. J. Plant Sci.* 49:791-796.

Ethephon and High Density Plantings Increase Yield of Pickling Cucumbers[1]

E. J. Hogue and H. B. Heeney[2]

Canada Department of Agriculture, Research Station, Saint Jean, Quebec

Abstract. **The application of (2-chloroethyl)phosphonic acid (ethephon) on pickling cucumber (*Cucumis sativus* L.) in the 2 to 3 leaf stage both at 100 and 400 ppm significantly increased the yield and farm value of this crop. A proportionately greater increase in value of the crop was obtained by decreasing the plant spacing from 30 x 30 cm, to 23 x 23 cm or 15 x 15 cm. The treatment yielding the highest value crop was obtained with the plant spacing of 15 x 15 cm and 400 ppm ethephon application.**

With increasing cost of labor to harvest pickling cucumbers, mechanical harvesting is a necessity. The nonselective or destructive harvest type favored over the multiple type harvester (2) requires adapting the cultural management of the crop. Morrison and Ries (4), working with the 'Spartan Dawn', reported that the highest return per unit area for once-over mechanical harvest of pickling cucumbers was obtained when planted 23 cm between plants in the row and 23 cm between rows. Robinson et al. (5) demonstrated that ethephon when applied in the 1st and the 3rd leaf stage greatly promoted the femaleness of the monoecious 'Wisconsin SMR 18'. McMurray and Miller (3) determined that the most effective concn of ethephon for promoting pistillate flowers were 120, 180 and 240 ppm, and further showed that ethephon significantly increased yields, as measured by value per unit area for 3 monoecious cultivars. George (1) showed that there was a differential response of monoecious cultivars to ethephon and suggested that this differential response to sex conversion by ethephon was affected by the genetic system controlling the female tendency in these cultivars. Sims and Gledhill (6) showed that ethephon treatments produced the same effect on sex expression and reduction in size of the gynoecious 'Piccadilly' as on the monoecious 'Wisconsin SMR 58'.

In preliminary trials in 1969, the cucumber 'Wisconsin SMR 15' was planted in rows spaced 15, 23 and 30 cm apart and 30 cm between plants in the row. Ethephon at 0, 100 and 400 ppm were applied as foliar sprays to the plants (4 to 5 leaf stage) at each spacings. All cucumbers were picked in

[1]Received for publication June 5, 1972.

[2]Smithfield Experimental Farm, Smithfield, Ontario. The authors acknowledge the advice of Dr. L. J. Coulombe and the technical help of A. Jacob and J. G. Metcalf.