

## MESSENGER A SYSTEMIC ACQUIRED RESISTANCE INFLUENCE ON COTTON

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### Abstract

The objective of the study was to evaluate the systemic acquired resistance (SAR) material, Messenger, on emergence, plant height, boll number and lint yields of cotton (*Gossypium hirsutum* L.). In 1997, boll number and lint yields of 'Deltapine 5690 RR' were higher after application of Messenger at first true leaf, pre-bloom, and early bloom compared to the control and higher than the growth regulator, Early Harvest, alone. Plants were significantly shorter after application of Messenger with the growth regulator, Pix, applied at first true leaf, pre-bloom, and early bloom than control. There was no significant difference between treatments for 1998 lint yield, number of bolls per plant, emergence, or plant height of 'Deltapine 458 BR'. However, there was a tendency for higher lint yields from the seed treated with Messenger compared to control. In 1999, the emergence and number bolls per plant were not significantly different. Plants for treatments with Pix application were significantly shorter than plants from other treatments. Significantly higher lint yields were obtained from treatment with Pix applied alone as compared to other treatments and lower from treatment with Actigard. Higher yields of cotton were obtained from treatments with three applications of Messenger at 4.4 oz/A and 2.2 oz/A and treatments with Early Harvest TST treated seeds and sprayed with Early Harvest TST as compared to the check. Generally, Messenger increased the boll number and lint yields in 1997 and had a tendency to increase lint yields of cotton in 1998 and 1999 as compared to control.

### Introduction

Messenger is a systemic acquired resistance (SAR) material, containing a harpin bacterial protein. Harpins are bacterial hypersensitive response (HR) inducing proteins that induce a rapid defense reaction involving localized death of cells and production of substances such as phenolics and phytoalexins at the site of infection thus preventing the pathogen or disease from spreading (Bonas, 1994). The HR triggers SAR which refers to distinct signal transduction pathways that play important roles in the ability of plants to defend themselves against pathogens (Ryals et al., 1996). The result is the

development of a broad-spectrum systemic resistance to pathogens or diseases (Hunt and Ryals, 1996; Neuenschwander et al., 1996).

The effect of Messenger through the biochemical changes in plants may result in increasing the yield in plants. This is new technology that is being investigated in many crops. Cotton is one of the largest crops in the Southeast and has the potential to produce profitable returns from applications of yield-enhancing materials.

The objective of this research was to evaluate the influence of application methods and timing of the SAR Messenger and growth regulators, Pix and Early Harvest, on emergence, plant height, boll number, and lint yield of cotton grown under strip-till conditions.

### Materials and Methods

The studies were conducted on a Dothan sandy loam (fine loamy siliceous, thermic Plinthic Kandiudult), at the North Florida Res. and Educ. Center, Quincy, FL in 1997 - 1999.

#### 1997

The winter fallow experimental area was sprayed with Roundup Ultra (Glyphosate) at 1 qt/A 2 wks before planting. Five days before planting, rows were ripped about 15 inch deep with a Brown Ro-till implement. Before planting, seeds were soaked in water with Messenger (40 ug/ml solution) or Early Harvest PGR (2 oz./gal H<sub>2</sub>O). DeltaPine 5690 RR cotton was planted strip-till using a Brown Ro-till implement and KMC planters at 4 seeds/ft of 36 inch wide row. Preemergence herbicides: Zorial at 1.5 lb/A + Cotoran at 1.25 qt/A + Prowl @ 2 pt/A + Gramoxone @ 1 pt/A were applied the day of planting. The preemergence and postemergence treatments comparing Messenger with other treatments are shown in Table 1. Messenger was applied at 35 gms/A, Pix was applied at 8 oz/A, and Early Harvest was applied at 2 oz./A. Pix is routinely put out two or three times to control cotton growth and help set bolls. Applications of Messenger or insecticides at the same time as Pix would add no additional cost to production. The experiment was sidedressed with 5-10-15 N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O at 300 lbs/A at 2 days after planting and sidedressed with 34-0-0 N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O at 200 lbs/A at 43 days after planting. Karate at 4 oz./A on 30 July, 12 and 26 August, 3 September, and Dimilin @ 6 oz./A + Lorsban at 1 pt/A was applied on 24 September to control insect pests. Plants were irrigated with 0.6 inch H<sub>2</sub>O on 15 July, 8, 13, 20, and 28 August, and 5, 15, and 19 September. On 21 October, the entire study was defoliated with Prep at 1.5 pt/A + Dropp @ 2.6 oz./A + Harvade @ 8 oz./A + Finish at 1.5 pt/A + Dash at 1 pt/A. Cotton was harvested on 18 November.

## 1998

DeltaPine '458 BR' cotton was planted in a similar manner to 1997 on 11 June. Before planting, DeltaPine 458 BR cotton seeds were coated with Messenger at 1 oz./100 lbs seeds. Fertilizer materials and rates, seeding rates, and herbicide were the same as 1997. On 12 and 17 June cotton was irrigated with 0.5 inch H<sub>2</sub>O. Messenger was applied at the rate of 40 ppm and Pix was applied at 8 oz./A on 26 June and again on 5 and 17 August (Table 2). On 23 September the study was defoliated with Dropp at 0.1 lbs/A + Finish at 1 qt/A and was harvested 3 weeks later.

## 1999

DeltaPine '458 BR' cotton was planted in a similar manner to 1997 and 1998 on 4 June. Before planting, DeltaPine 458 BR cotton seeds were coated with Messenger at 4.4 oz./100 lbs seeds or Early Harvest TST at 2.2 oz./100 lbs seeds. Fertilizer materials and rates, seeding rates, and herbicide were the same as 1997 and 1998. On 4 and 21 June, 27 July, 6, 23, and 30 August, and 15 September cotton was irrigated with 0.5 inch H<sub>2</sub>O. Messenger was applied foliar at the rate of 2.2 and 4.4 oz./A, Early Harvest at 3 oz./A, and Pix was applied at 8 oz./A (Table 3). On 22 October the study was defoliated with Dropp at 0.7 lbs/A + Prep @ 22 oz./A + Finish @ 24 oz./A + Agridex @ 1 pt/A and was harvested on 8 November.

Cotton emergence was obtained by counting plants from two center rows 2 weeks after planting. Number of mature bolls per plant was obtained at maturity along with weight of a single boll, and seed cotton yield (seed plus lint). Lint yield was calculated as 38% of seed yield.

The experimental design was a randomized complete block design with 4 blocks. Data were analyzed using SAS (1989) by analysis of variance, and means were separated using Fisher's Least Significant Difference Test at the 5% probability level.

## Results

In 1997, all Messenger treatments differed significantly for lint yield from the control including cotton seeds soaked in Early Harvest (Table 1). Generally, there was no significant difference between treatments in plant height after 60 days after planting and also no significant difference between treatments after 90 days after planting except for the treatment that had Messenger with Pix where cotton was shorter. This was expected since Pix is routinely used to reduce plant height and increase boll set. Boll number and lint yield were higher after spraying Messenger only with no seed soak as compared to control and other treatments. Seed soak with Messenger reduced the boll number per plant and lint yield as compared to no seed soak with Messenger. The increased boll number probably resulted in a significant increase in lint yield.

In 1998, there were no significant differences for plant emergence, plant height at 60 or 90 days after planting, number bolls per plant, and lint cotton yield (Table 2). Severe "hard lock" (not properly matured cotton bolls) problems were encountered, caused by a hurricane and high humidity near harvest decreased yields of cotton. However, higher lint yields were obtained from treatment with Messenger sprayed at 1<sup>st</sup> true leaf and 1<sup>st</sup> bloom, treatment with Messenger sprayed at 1<sup>st</sup> true leaf, 1<sup>st</sup> bloom, and boll set, treatment with Messenger treated seeds, and treatment with Messenger sprayed at 1<sup>st</sup> true leaf.

In 1999, the emergence and number bolls per plant were not significantly different (Tab. 3). Plants for both treatments with Pix application at 10<sup>th</sup>, 12<sup>th</sup>, and 14<sup>th</sup> node were significantly shorter than plants for other treatments. Lint yields of cotton were significantly higher from treatment with Pix applied alone as compared to other treatments and lower from treatment with Actigard sprayed at 1st true leaf, early bloom, and 3 weeks later. Higher yields of cotton were obtained from treatments with three applications of Messenger (1st true leaf, early bloom, and 3 weeks later) at 4.4 oz/A and 2.2 oz/A (113.4% and 109.0% yield of control, respectively), treatment with Early Harvest TST treated seeds and sprayed with Early Harvest TST at pinhead square and early bloom, and also treatment with Early Harvest TST sprayed 3-5 leaf stage, pinhead square, and early bloom as compared to the check.

## References

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Table 1. Influence of Messenger, Pix, and Early Harvest on emergence, height, boll number and lint yield of cotton in 1997.

Seed soak†	Treatments‡	Emergence -- % --	Plant height Days after planting		# bolls per plant no.	Lint yield lb/A
			60 -- inch --	90 -- inch --		
Messenger	Messenger	73	40.9	60.6	13.2	1191
No	Messenger	79	41.3	61.0	15.7	1350
No	Messenger + Pix	80	30.7	42.5	12.4	1134
Early Harvest	Early Harvest	65	40.6	60.6	13.3	1029
Early Harvest	No	80	40.9	59.8	13.3	1077
Check (no treatments)	77	40.9	59.8	12.3	942	
LSD <sub>(0.05)</sub>	14	2.36	3.15	1.4	122	

† DeltaPine '5690 RR' cotton seeds soaked in 40 mg/ml Messenger solution for 1 h or soaked in 0.2 oz./1 gal H<sub>2</sub>O. Seeds dried after treatment before planting.

‡ Messenger applied over the cotton canopy three times (1<sup>st</sup> true leaf, pre-bloom, and early bloom) at 35 gms/A, Pix applied three times (1<sup>st</sup> true leaf, pre-bloom, and early bloom) at 8 oz/A, Early Harvest applied at 1<sup>st</sup> true leaf, pre-bloom, and early bloom at 0.2 oz/A.

Table 2. Influence of Messenger and Pix on emergence, height, boll number and lint yield of cotton in 1998.

Treated seed†	Time of spraying		Emergence %	Plant height days after planting		# bolls per plant no.	Lint yield lb/A
	Messenger‡	Pix§		60 -- inch --	90 -- inch --		
Yes	No	No	82	28.0	39.0	14.8	527
Yes	1 <sup>st</sup> bloom	No	89	28.7	40.9	13.8	428
No	1 <sup>st</sup> true leaf	No	85	31.5	45.3	13.8	521
No	1 <sup>st</sup> true leaf & 1 <sup>st</sup> bloom	No	79	30.3	39.4	13.8	581
No	1 <sup>st</sup> true leaf & 1 <sup>st</sup> bloom & boll set	No	76	28.7	42.5	12.7	549
No	1 <sup>st</sup> true leaf & 1 <sup>st</sup> bloom & boll set	1 <sup>st</sup> bloom & boll set	72	30.3	37.8	13.8	434
No	No	1 <sup>st</sup> bloom & boll set	71	31.5	38.6	12.7	378
Check (no treatment)			76	32.3	41.3	14.8	410
LSD <sub>(0.05)</sub>			NS	NS	NS	NS	NS

† DeltaPine '458 BR' cotton seeds were treated with Messenger (dry coating) at 1 oz/100 lbs before planting.

‡ Messenger applied by spraying over the cotton canopy at 40 ppm.

§ Pix applied by spraying over the cotton canopy at 8 oz/A.

Table 3. Influence of Messenger and Pix on emergence, height, boll number and lint yield of cotton in 1999.

Treated seed†	Time of spraying				Emergence	Plant height days after planting		# bolls per plant	Lint yield
	Messenger††	Actigard‡	Early Harvest ‡‡	Pix§		60	90		
					%	inch		no.	lb/A
Messenger	No	No	No	No	81	21.3	38.6	15.8	868
No	1 <sup>st</sup> true leaf* Early bloom 3 wks later	No	No	No	82	22.7	40.1	16.4	1124
No	1 <sup>st</sup> true leaf** Early bloom 3 wks later	No	No	No	83	21.6	40.0	19.5	1169
No	10 <sup>th</sup> node 12 <sup>th</sup> node 14 <sup>th</sup> node	No	No	10 <sup>th</sup> node 12 <sup>th</sup> node 14 <sup>th</sup> node	81	20.5	29.8	14.8	968
No	No	1 <sup>st</sup> true leaf Early bloom 3 wks later	No	No	74	20.9	41.0	17.4	803
Early Harvest	No	No	No	No	76	22.9	39.5	17.8	1028
Early Harvest	No	No	Pinhead square Early bloom	No	73	22.3	41.6	17.2	1093
No	No	No	3-5 leaf Pinhead square Early bloom	No	76	22.7	41.3	18.3	1049
Messenger	Pinhead square	No	No	No	79	22.0	40.1	20.7	1029
No	No	No	No	10 <sup>th</sup> node 12 <sup>th</sup> node 14 <sup>th</sup> node	81	21.4	29.4	14.8	1267
					74	21.6	39.0	14.8	1031
					NS	1.1	1.5	NS	89

† DeltaPine '458 BR' cotton seeds treated with Messenger (dry coating) at 4.4 oz/100 lbs or Early Harvest TST at 2 oz/100 lbs before planting.

†† Messenger applied by spraying over the cotton canopy

- \* 1<sup>st</sup> true leaf, early bloom, and 3 wks later at 2.2 oz/A
- \*\* 1<sup>st</sup> true leaf, early bloom, and 3 wks later at 4.4 oz/A

‡ Actigard applied at 1 oz/A.

‡‡ Early Harvest TST applied at 3 oz/A

§ Pix applied by spraying over the cotton canopy at 8 oz/A.