# ASSET™ as an In-Furrow Application to Enhance Early-Season Growth and Lint Yield

*A. Steger, D.M. Oosterhuis, W.C. Robertson, C. Guo, D. Coker, and A. Daniel*
Department of Agronomy, University of Arkansas, Fayetteville, AR 72701 USA

## ABSTRACT

*The establishment of a uniform and vigorous stand is essential for producing a high yielding cotton (Gossypium hirsutum L.) crop. Germination, emergence and seedling establishment are adversely affected by unfavourable environmental conditions often experienced in the Mississippi Delta Region of the USA. Preplant in-furrow applications of fertilizer additives have been reported to enhance root growth, water and nutrient uptake and lint yield potential. ASSET™ was applied in-furrow to cotton grown under field and controlled environmental conditions and the effect on seedling emergence, plant height, root growth and lint yield measured. In the controlled environment studies, seedling emergence was enhanced at six days after planting (DAP). Leaf area, total root length, and the number of lateral roots were numerically higher at four weeks after planting. Plants exposed to cooler temperatures and mechanical damage (removal of one cotyledon) had higher total dry weights; however, differences were not significant or consistent. Results from field studies were variable and inconsistent. Seedling emergence was slightly enhanced in the ASSET treatment in two of the three years of field data (1996 and 1997). Plant height at 73 DAP (1996) increased when compared with the untreated control although differences were not significant. The number of squares in the ASSET treatment in 1997 was significantly higher ($P<0.05$) indicating a potential for higher lint yield. Yields were not significantly increased in 1997. Yield data from the field study in 1998 are not available yet. Though the data are still inconclusive, ASSET appears to offer some advantage in promoting early season root growth but the effects on lint yield have been non-significant. Additional research is needed to observe the effects of ASSET on lint yield and on cotton seedlings exposed to stress conditions that represent at potential climatic conditions at planting.*

## Introduction

Cotton (*Gossypium hirsutum* L.) is an indeterminate plant with a vigorous growth habit and one of Arkansas' most important agricultural commodities. The establishment of a uniform, vigorous stand early in the season is a key to producing high yielding crops. Germination, emergence and seedling development depend on favourable soil and climatic conditions, often unpredictable at planting. This can create unfavourable conditions for stand establishment and seedling growth. A moist soil with a minimum temperature of 20°C is required for successful germination (Brown and Ware, 1958). However, it is not uncommon for the Mississippi Delta to experience night temperatures below 20°C after planting when seedlings are sensitive to adverse environmental conditions. Preplant in-furrow fertilizer additives, when applied in conjunction with sound management practices, may increase root development and enhance lint yield production. ASSET (Helena Chemical Company, Memphis, Tennessee, USA) is a proprietary fertilizer additive containing magnesium, ammonium, and carboxylates that may lead to healthier root systems that tolerate adverse weather conditions. This paper summarizes experiments at University of Arkansas (1993 to 1998) to observe the effect of in-furrow applications of ASSET on cotton grown in controlled environments and under field conditions and on seedlings exposed to cool temperatures or mechanical damage.

## Material and Methods

***Controlled Environment Studies.*** Cotton (*G. hirsutum*) cultivars DPL 50 (1993), DPL 20 (1995 and 1996) and Suregrow 125 (1998) were planted in washed builder's sand in two litre pots. The growth chamber was programmed for 30o/25oC (day/night) temperature cycles and a relative humidity of 60 to 80%. Plants were watered with deinonized water and 50% Hoagland solution on alternate days. Treatments in the 1998 study consisted of (1) exposure to temperatures of 18.3/15.6oC for one week following planting and (2) removal of one cotyledon ten days after planting. Application rates were ASSET applied in-furrow at 0.15-L ha-1 in 1993 and in-furrow at 0.4-L ha-1 in 1995, 1996 and 1998. Measurements included percent seedling emergence, plant height, main-stem node number, leaf area, number of lateral roots, total root length and dry weights two weeks after planting in 1993, 1995, and 1996 and at weekly intervals until four weeks after planting in 1998.

***Field Studies.*** Field studies were conducted from 1995 to 1998, including on farm studies in Southeast Arkansas in 1997. The cotton cultivar DPL 20 (1995 and 1996) and Suregrow 125 (1997 and 1998) was planted in a Captina silt loam (fine-silty, mixed mesic Typic Fragiudults) at the Arkansas Agricultural Research and Extension Centre, Fayetteville and a Hebert silt loam (fine-silty, mixed thermic Aeric Ochraqualfs) at the Southeast Research Station, Rohwer. All plantings occurred in early May. Treatments consisted of an untreated control and in-furrow application of ASSET at a rate of 0.4 L $ha^{-1}$. Percent seedling emergence was recorded at four and ten days after planting (DAP) in 1995, six and eleven DAP in 1996, nine and thirty DAP in 1997 and seven, nine and twelve DAP in 1998. Plant height and number of main-stem nodes were measured at 28 DAP in 1996 and 1998 and the number of squares and bolls at 73 DAP in 1996. Lint yield in 1997 was calculated by mechanically harvesting all plots. The 1998 study was not harvested until after this paper was written.

## Results and Discussion

***Controlled Environment Studies.*** Table 1 shows percent seedling emergence at four, six, and eight DAP. At six DAP, in-furrow application of ASSET increased emergence by 26% and 15% at the lower rate (0.15 L $ha^{-1}$) and the recommended rate (0.4 L $ha^{-1}$), respectively. In the same studies, root growth was similarly affected, although differences were not significant (Table 2). In a separate study (Figure 1), differences between the untreated control and the ASSET treatment were more apparent at three and four weeks after planting. Leaf area was numerically higher at four weeks after planting in the ASSET treatment; number of lateral roots at two, three and four weeks after planting was also numerically higher in the ASSET treatment, with significant differences at four weeks after planting. Total root length followed a similar pattern. Total dry weight of plants exposed to cool temperatures following planting and mechanical damage (removal of one cotyledon) also increased with an in-furrow application of ASSET but differences were not significant or consistent (Table 3).

***Field Studies.*** Results from field studies with ASSET were variable and inconsistent. Seedling emergence was slightly enhanced in the ASSET treatments in field data in 1996 and 1997, while germination was apparently unaffected by treatment in 1998 (Figure 2). In 1996, plant height at 73 DAP (approximately first flower) increased when compared with the untreated control although differences were not significant (Figure 3). The number of main-stem nodes was not affected by ASSET. However, at 73 DAP, the number of squares in the ASSET treatment was significantly increased when compared with the untreated control (P=0.05). Lint yield in 1997 was 1386 kg $ha^{-1}$ and 1374 kg $ha^{-1}$ in the control and ASSET treatments, respectively (Robertson, 1998) and not significantly different (P>0.05). In 1998, plant height was 9.9 cm and 9.7 cm at pinhead square (42 DAP) in the ASSET and the control treatments, respectively. Lint yield is not available for the 1998 field study.

## Conclusions

Results from controlled environment studies show that ASSET can improve seedling emergence and early-season growth of cotton (Oosterhuis *et al*, 1996 and Steger and Oosterhuis, 1997). However, field studies have been less conclusive (Robertson, 1998) with no significant effect on lint yield. The studies on the effect of low temperature and mechanical damage, although inconclusive, suggested there may be some benefit to seedling growth from ASSET under these environmental conditions. Additional research is needed on ASSET and lint yield as well as on the affects of ASSET on cotton seedlings exposed to stress conditions that represent potential climatic conditions at planting, e.g. cool soil temperatures (< 20$^{o}$C), hail and wind damage and flooding.

## References

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**Table 1. Percent seedling emergence in plants receiving in-furrow application of 0.15 L $ha^{-1}$ ASSET and 0.4 L $ha^{-1}$ ASSET.**

| Year | Treatment | Seedling Emergence (%) | | |
|---|---|---|---|---|
| | | 4 DAP† | 6 DAP | 8 DAP |
| *1993* | Untreated control | ‡ | 36 | 48 |

| | | | | |
|---|---|---|---|---|
| | ASSET @ 0.15 L ha-1 | ‡ | 48 | 56 |
| *1995* | Untreated control | 32 | 73 | ‡ |
| | ASSET @ 0.4 L ha-1 | 53 | 100 | ‡ |
| *1996* | Untreated control | 7 | 73 | ‡ |
| | ASSET @ 0.4 L ha-1 | 20 | 86 | ‡ |

†Days after planting
‡Data not available

**Table 2. Root dry weight, tap root length, total root length, and number of lateral roots in plants receiving in-furrow application of 0.15 L ha-1 and 0.4 L ha-1 ASSET.**

| Year | Treatment | Root Dry Weight (g) | Tap Root Length (cm) | Total Root Length (cm/plant) | Number of Lateral Roots (#/plant) |
|---|---|---|---|---|---|
| *1993* | Untreated control | 0.06 | 16.6 | 481 | 67 |
| | ASSET@0.15L ha-1 | 0.08 | 30.3 | 700 | 92 |
| *1995* | Untreated control | 0.16 | 17.7 | 182 | 31 |
| | ASSET@0.4L ha-1 | 0.15 | 20.1 | 215 | 34 |
| | LSD | 0.05 | 7.3 | 57.9 | 28.9 |
| *1996* | Untreated control | 0.08 | 10.7 | 142 | 67 |
| | ASSET@0.4L ha-1 | 0.08 | 13.1 | 141 | 56 |
| | LSD | 0.03 | 4.1 | 32.9 | 11.8 |

**Table 3. Total dry weight of cotton exposed to cool temperature (18.3/15.6₀C) for seven DAP and mechanical damage (removal of one cotlyledon at ten DAP).**

| Damage Level | Total Dry Weight (g/plant) | | | |
|---|---|---|---|---|
| | 33 DAP | | 40 DAP | |
| | Control | ASSET | Control | ASSET† |
| Untreated Control | 1.7 | 1.8 | 3.7 | 3.2 |
| Cool temperature | 0.7 | 0.9 | 1.0 | 1.6 |
| Cotyledon Removal | 1.3 | 1.6 | 2.8 | 3.0 |
| LSD (0.05) | NS | | NS | |

†Rate of application= 0.4 L ha-1.

**Figure 1. Plant height, leaf area, number of lateral roots and total root length of plants receiving in-furrow application of ASSET, harvested at weekly intervals and after planting and grown in a controlled environment.**

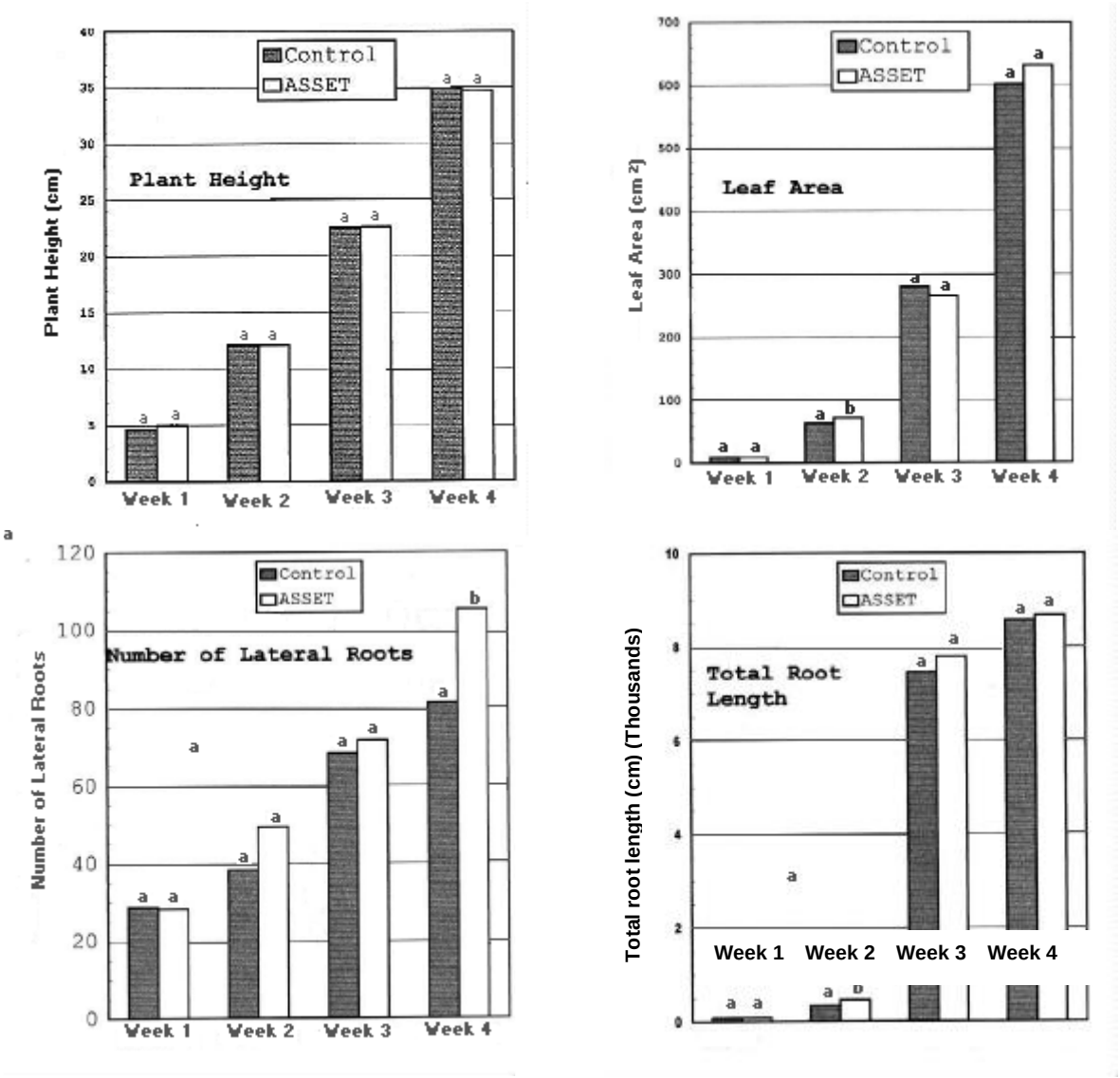
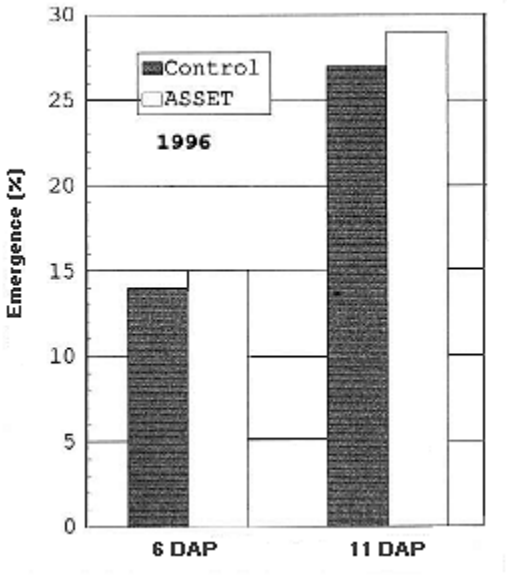
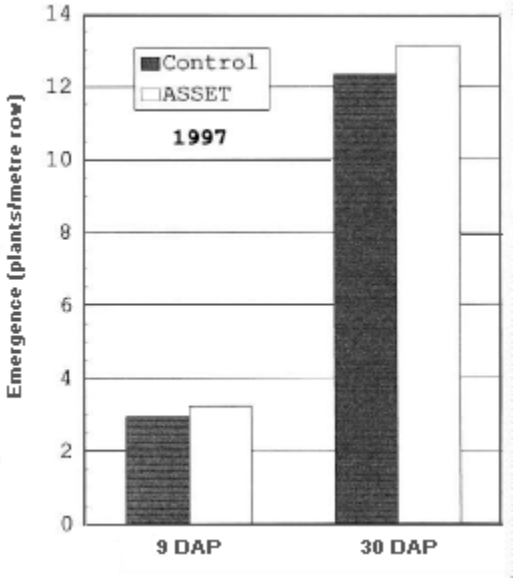


**Figure 2. Seedling Emergence in Plants Receiving In-Furrow application of 0.4 l/ha ASSET. Field Studies 1996, 1997, 1998.**



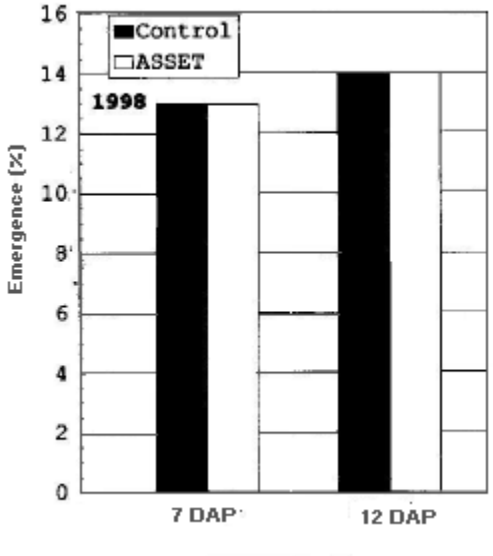



**Figure 3. Plant height, number of main stem nodes at 28 and 73 DAP and the number of squares and bolls at 73 DAP. Field study, 1996. Columns headed by the same letter within a samplng date are not significantly different (P>0.05).**