TITLE:

Cotton Insect Pests and Natural Enemies in Conventional and Conservation Tillage Systems at AG-CARES, Lamesa, TX, 2002.

AUTHORS:

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INTRODUCTION:

Cotton is a major crop grown in Texas, with 6 million acres planted and over 4 million bales of lint produced in 2001. Simultaneous use of several cultural practices has greatly aided to sustainable cotton production in Texas. Adoption of the minimum tillage (conservation tillage) approach to cotton production in Texas has increased steadily over the last few years primarily due to its multiple advantages such as reduction in soil erosion, conservation of soil moisture, maintenance of soil structure, and decreased production costs. Similarly, the rate of adoption of transgenic cultivars, particularly those with herbicide resistant genes, has also increased in Texas cotton production. The adoption rate of transgenic cultivars with Bt gene has been about 10% in Texas, while the Texas High Plains plants 5-7% of its cotton acreage with Bt-cotton. Information on arthropod biology and behavior as affected by cultural practices such as cultivars, planting date, and tillage practices are lacking from the Texas High Plains cotton production system.

OBJECTIVES:

1. To characterize population abundance patterns of cotton pests and predators in cotton agroecosystems in the Texas High Plains.
2. To evaluate the influence of Bt transgenic cotton, conservation tillage system, and planting date on the seasonal abundance and distribution patterns of cotton pests and arthropod predators.
3. To evaluate the efficacy of different sampling methods for cotton arthropod predator sampling.

MATERIALS AND METHODS:

Experimental site: Agricultural Complex for Advanced Research and Extension Systems (AG-CARES) farm, near Lamesa, Texas.

Experimental design: Randomized complete block design with 3 replications.

Treatments: Three treatments- Cultivar and planting date within each tillage system. Tillage system will be replicated by year.

Tillage: Conventional and conservation tillage

Cultivars: Paymaster 2326BGRR (Bt cotton) and Paymaster 2326RR (non-Bt cotton).

Planting date: May 9 (timely planting) and June 10 (late planting), 2002.

Arthropod sampling duration and interval: Weekly from May 15 to Sept 24.

Sampling methods: Thrips were sampled only in timely planted cotton and only by visual sampling method. Predators and all other pests were sampled in both timely and late planted cotton using the six sampling methods listed below.

1. Beat bucket (dia. 12 inch, ht. 15 inch): 12 plants/plot.
2. Visual: 5-10 plants/plot thoroughly examined.
3. Vacuum (30 seconds) sampled approximately 500 plants/plot.
4. Pitfall: 2 cups/plot (cup size-3.5 inch diameter, 4 inch height).
5. Drop cloth: 10 plants/sample, 4 samples/plot6. Sweepnet (14.5 inch dia.) sampled approximately 604 plants/plot.

Row spacing: 40-inch

Plant density: 62,000 plants per acre

Soil type: Sandy loam

Insecticide application: No insecticide used in-furrow but a synthetic pyrethroid (Karate) was applied by aerial spray at early square stage for the control of bollworms on July 11, 2002.

Irrigation: 13.91 inches during crop season by center pivot system equipped with LEPA (low energy precision application) nozzles.

Data analysis: Natural enemy data were converted to numbers/row-meter; cotton aphid data are reported as numbers/leaf. Data were analyzed using an analysis of variance and means were compared using the least significant difference method (SAS Institute 2000).

Arthropods sampled:

Predaceous bugs: Minute pirate bug: *Orius* spp.
Damsel bug: *Nabis* spp.
Big-eyed bug: *Geocoris* spp.
Wheel bug: *Arilis cristatus* Assassin bug: *Zelus renardii*

Predacious beetles: Convergent lady beetle: *Hippodamia convergens*
Soft-winged flower beetle: *Collops* spp.
Scymnus beetle: *Scymnus loewii*
Hooded beetle: *Notoxus* spp.

Green lacewing: *Chrysoperla* spp.

Spiders: Predominantly *Misumenops* spp.

Ground-dwelling beetles: Tiger beetles: *Megacephala carolina**;** Cicindela sexguttata*
Black ground beetle: *Pterostichus* spp.
Scaritini beetle: *Pasimachus* sp.
Fiery searcher beetle: *Calosoma scrutator*

Pest species: Cotton aphids: *Aphis gossypii*
Cotton fleahoppers: *Pseudatomoscelis seriates*
Thrips: Western flower thrips, *Frankliniella occidentalis*
Plant bugs: *Lygus* spp. (*L. hesperus* and *L. elisus*)

RESULTS AND DISCUSSION:

Thrips

Abundance Pattern. Thrips infestation began at the cotyledon stage of cotton. Mostly migratory adult thrips were observed in the first week of cotton emergence (12 days after planting, DAP). Thrips were mostly found on top growing leaf terminal and lower surface of young true leaves and reproduced rapidly (4.6 per plant) by the 1-2 true leaf stage (20 DAP). Because thrips are very minute, highly mobile and are mostly hidden under unfolded leaves in cotton terminals, special care should be taken while monitoring their populations. We used a white foam plate to dislodge thrips from the plant before counting. Thrips population showed two distinct peaks, the first in early 1-2 true leaf stage (20 DAP) and the second peak at flowering stage (96 DAP) (Fig. 1). In the first peak, thrips numbers reached up to 6.1 total thrips per plant and the number slowly declined as the plant matured and began squaring. However, once cotton started flowering (75 DAP), thrips population began to grow and attained the second peak in the second week of August (96 DAP); the second peak was larger than the first peak. Thrips were mostly found inside the flowers during the second peak. Thrips numbers began to decline rapidly after 110 DAP (third week of August) and reached to undetectable level in early September when cotton plants attained >50% open-boll stage (124 DAP).

Effect of tillage. For the first three weeks of observation (i.e., 12, 20 and 27 DAP or cotyledon to 4 true leaf stage), conventional tillage plots had significantly more thrips compared to the conservation tillage plots. However, for the rest of the growing season, thrips abundance was similar between conventional and conservation tillage plots. Although seasonal average number of thrips in conventional tillage system (4.3 per plant) was higher than that in conservation tillage (3.6 per plant), these values were not significantly different (Fig. 2). Thrips abundance patterns in both tillage systems were similar in seasonal activity patterns as well. Both conventional and conservation tillage showed two population peaks, one at 20 DAP and the next at 96 DAP.

Effect of Cultivar. Thrips abundance did not vary between non-Bt and Bt cotton cultivars. Seasonal average abundance of thrips in Bt cotton plots (3.7 per plant) was only slightly lower than that in non-Bt cotton plots (4.2 per plant) (Fig. 2). Thrips abundance patterns in both cultivars were similar with both showing two population peaks at 20 DAP and 96 DAP. Thrips abundance was not affected by tillage and cultivar interaction.

Cotton fleahoppers

Abundance Pattern. On average, 98 adults and 78 nymphs per acre were found in the first week of sampling (44 DAP; 6-8 true leaf stage). Fleahoppers were mostly found on new leaf buds and young squares where they reproduced rapidly (>200 nymphs per acre). As cotton began squaring and advanced to the blooming stage, fleahopper nymph numbers declined slowly and reached an undetectable level by 75 DAP. Thus, there were only adult fleahoppers after 75 DAP. Fleahopper abundance showed only one population peak (3,198 fleahoppers per acre) at 103 DAP (Fig. 3). No fleahoppers were detected after 135 DAP (95% boll opening stage).

Effect of planting date. Fleahopper abundance was often higher in late-planted cotton compared with that in timely planted cotton (Fig. 4). The seasonal average number of fleahoppers in late-planted cotton (1,911 per acre) was significantly higher ($p=0.0001$) than in timely planted cotton (790 per acre). The highest abundance (3,167 per acre) of fleahoppers in timely planted cotton was observed on August 20 (103 DAP), whereas the highest abundance (7,493 per acre) in the later planted cotton was observed on August 27 (78 DAP).

Effect of tillage. Fleahoppers showed a single population peak in the soft boll stage (103 DAP in timely planted cotton) in both tillage systems, with population peaks of 2,567 and 3,830 per acre in conservation and conventional tillage systems, respectively. After reaching the peak, fleahopper

abundance slowly declined as the plant matured and bolls began hardening, and the numbers reached to undetectable level at 135 DAP (>95% open boll stage) in both tillage systems. Seasonal average numbers of total fleahoppers were 2,114 and 1,708 per acre in conventional and conservation tillage systems, respectively (Fig. 5). For most sampling dates, average fleahopper numbers in conservation tillage plots were slightly lower than in conventional tillage plots, but the tillage system did not have a significant influence on the abundance patterns of fleahoppers ($P = 0.14$) (Fig. 5).

Effect of Cultivar. The analysis of variance revealed no significant difference ($P= 0.17$) in fleahopper abundance between the transgenic-Bt (1,665 fleahoppers per acre) and non-Bt (2,158 fleahoppers per acre) cotton cultivars (Fig. 5).

Efficiency of sampling methods. Sampling methods varied significantly in their ability to capture fleahoppers ($P=0.0001$). Although the visual sampling method was more time-consuming than other methods, it detected the most fleahoppers (Fig. 6). Visual sampling method captured 37,851 fleahoppers/acre followed by beat bucket (17,086 per acre), drop-cloth (8,378 per acre), vacuum (951 per acre), and sweepnet (798 per acre) sampling.

Cotton aphids

Seasonal Abundance. Aphid activity started on June 5 at 2-4 true leaf stage (27 DAP) and the number increased rapidly to reach only one peak population (40 aphids per leaf) on August 6 at the boll development stage (89 DAP) (Fig. 7). After this peak, the aphid numbers declined to undetectable level within a week. Figure 7 clearly illustrates the significant negative relationship between cotton aphid abundance and total predator abundance.

Effect of tillage, planting date, and cultivar. Cotton aphid abundance was significantly influenced by tillage system and planting date, but not by cotton cultivar. Significantly higher numbers of aphids were found in late-planted cotton and in conservation tillage system. (Fig. 8)

Arthropod predators

Seasonal abundance. Predator activity started during the cotyledon stage. The total predator population increased as plants grew older and the number of insect pests increased. The total predator population exhibited two population peaks, the first peak on June 26 and the second peak occurring immediately after the aphid population peak on August 13 (Fig. 9). Predaceous beetles were the most dominant foliage-dwelling predators followed by spiders, predatory bugs, and lacewings.

Effect of tillage and planting date. Tillage system and planting date had no significant effect on foliage-dwelling predatory arthropods. Ground-dwelling predators were significantly more abundant in conservation tillage plots than in conventional tillage plots during early season but during the remainder of the season there was no significant difference in ground dwelling predator abundance in the two tillage systems (Fig.10).

Efficacy of sampling methods. Overall, visual method detected the highest abundance of all predator groups, followed by beat bucket, drop cloth, sweepnet, and vacuum sampling methods (Fig. 11).

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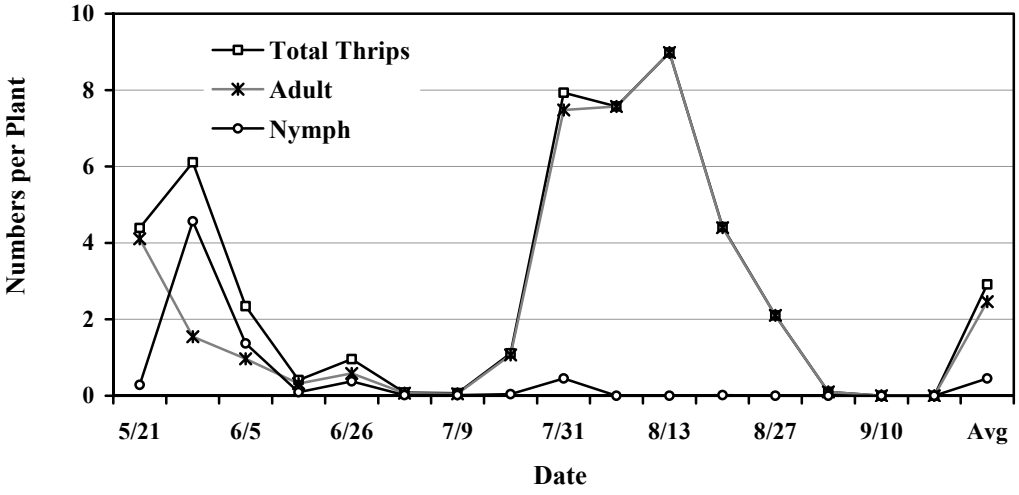


Fig. 1. Seasonal abundance patterns of thrips detected by visual sampling in timely (May) planted cotton at Lamesa, Texas, 2002.

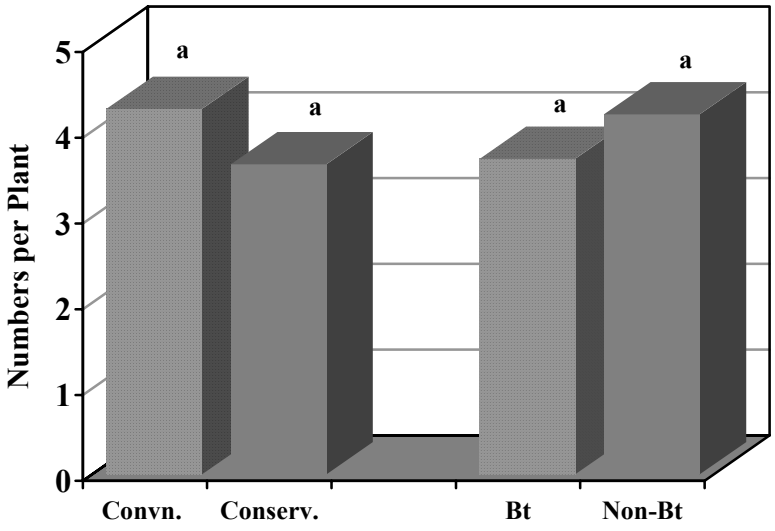


Fig. 2. Seasonal average number of thrips detected by visual sampling in timely (May) planted cotton at Lamesa, Texas, 2002.

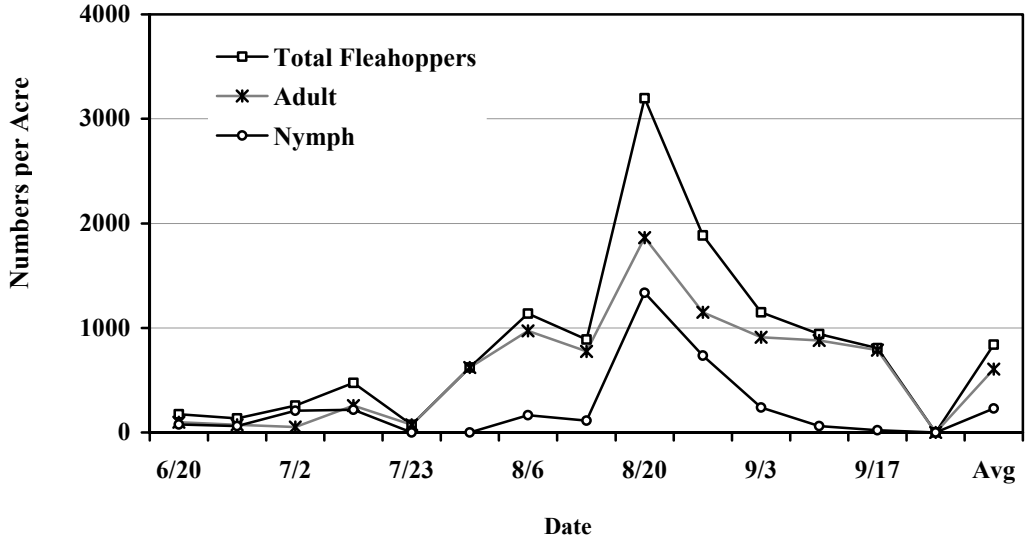
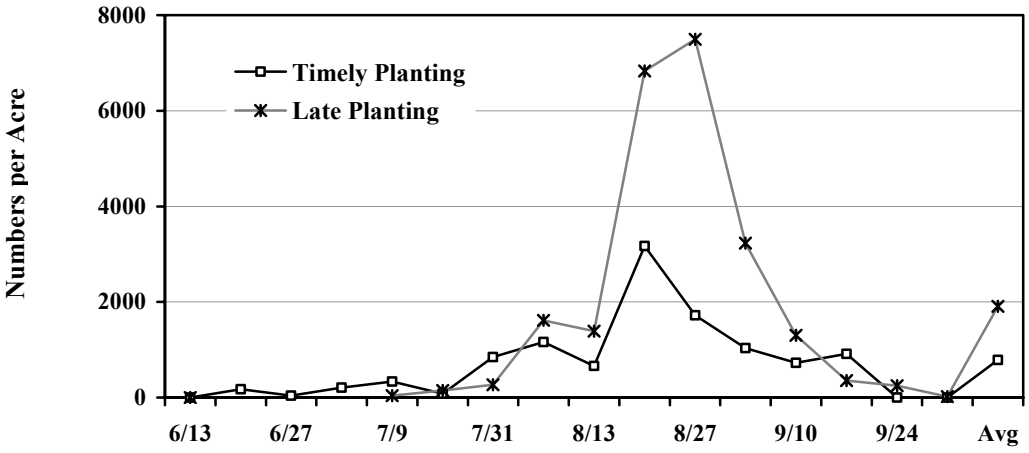


Fig. 3. Seasonal patterns of fleahoppers detected by vacuum sampling in timely (May) planted cotton at Lamesa, Texas, 2002.



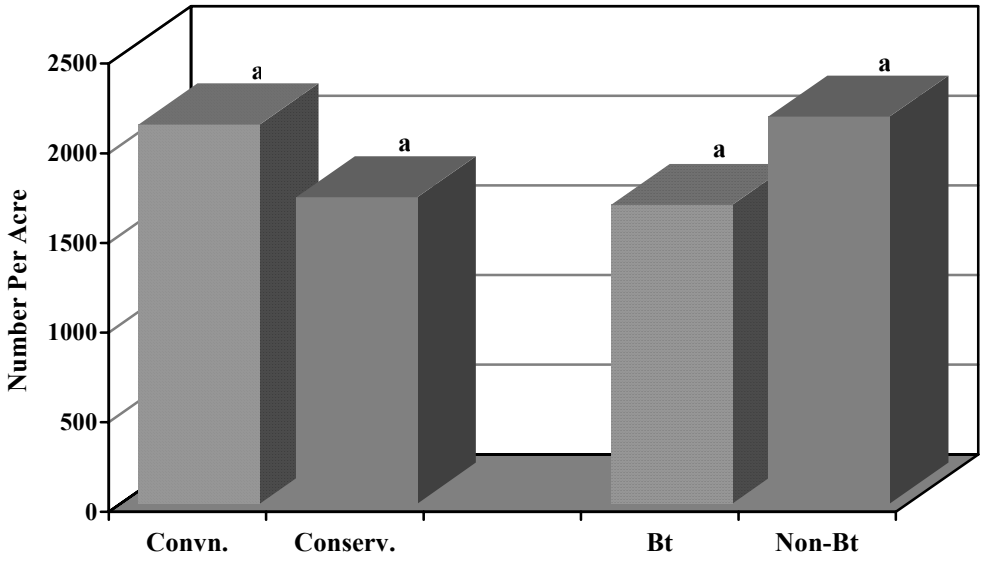


Fig. 5. Seasonal average number of fleahoppers per acre detected in two cotton tillage systems and two cultivars at Lamesa, Texas, 2002.

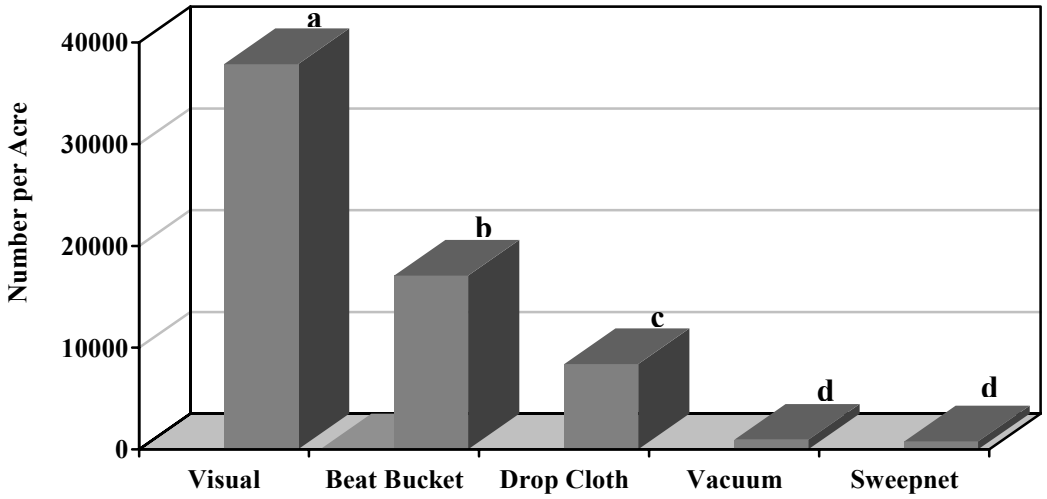


Fig. 6. Seasonal average number of fleahoppers per acre detected by five sampling methods at Lamesa, Texas, 2002.

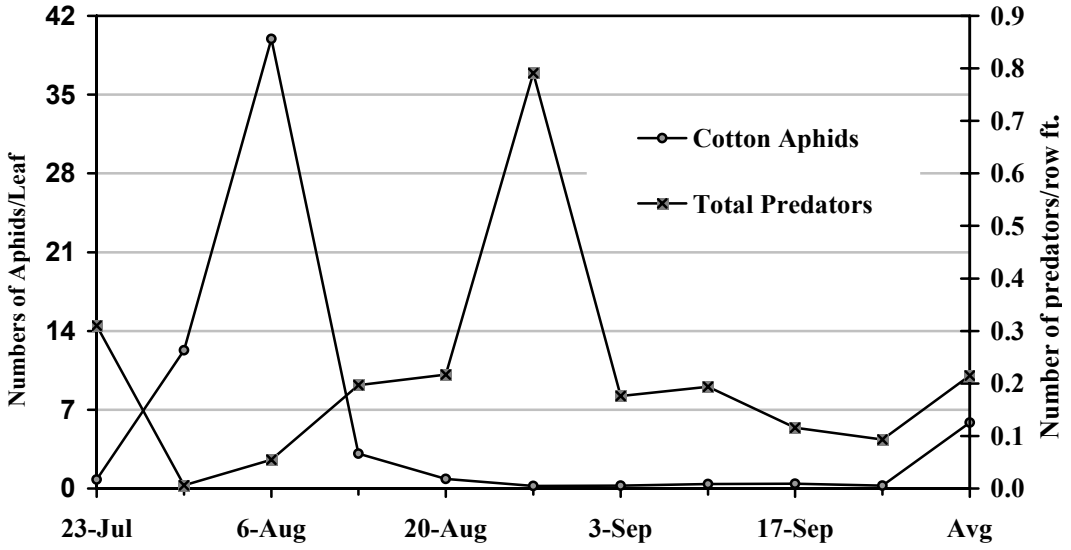


Fig. 7. Seasonal abundance of cotton aphids and total predators in cotton at Lamesa, Texas, 2002.

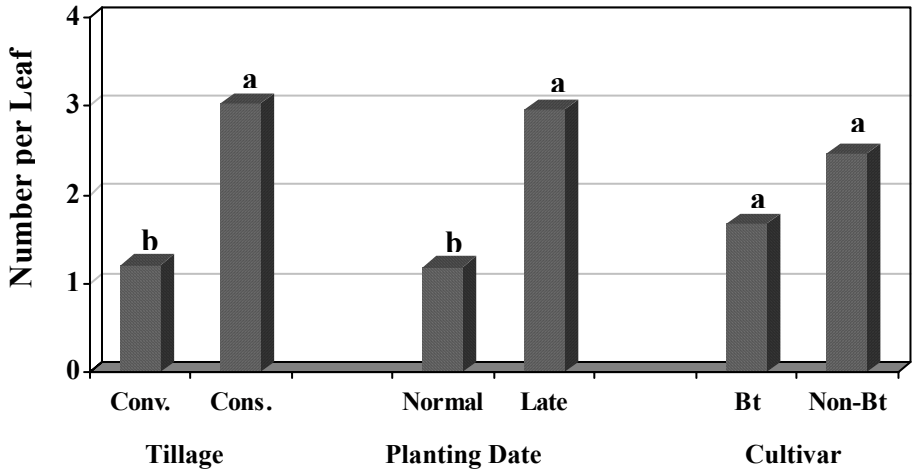


Fig. 8. Seasonal abundance of cotton aphids as affected by tillage system, planting date, and cotton cultivar. Lamesa, Texas, 2002.

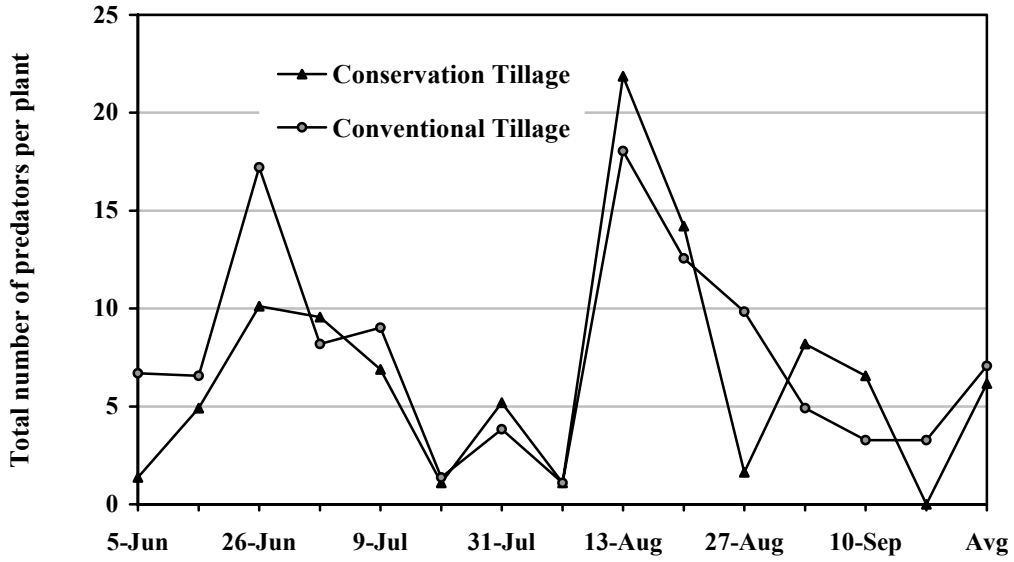


Fig. 9. Seasonal abundance of total predators detected by visual method in timely (May) planted cotton. Lamesa, Texas, 2002.

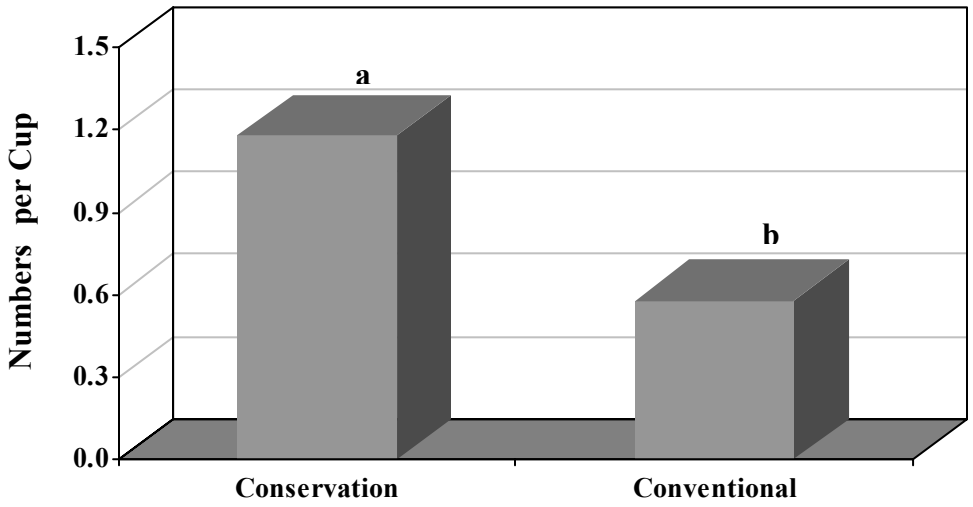


Fig. 10. Average seasonal abundance of ground beetles detected by pitfall traps located in cotton grown under two tillage systems. Lamesa, Texas, May 15 to June 26, 2002.

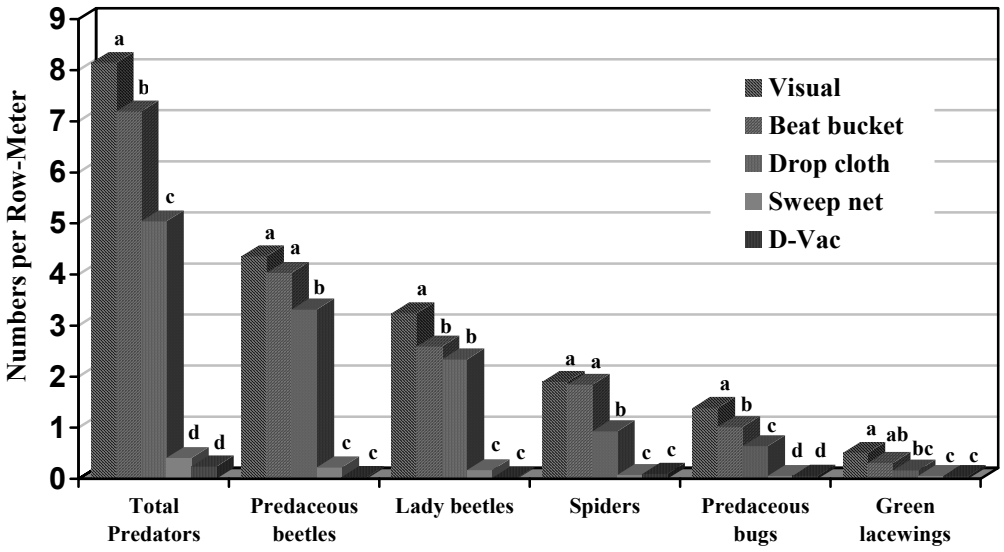


Fig. 11. Predator abundance detected by different sampling methods. Lamesa, Texas, 2002.