Alternative bollworm control strategies for the small-scale farmer

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ABSTRACT

*A study was conducted for two seasons at Rustenburg in the Northwest province and Zamekomstrus in Mpumalanga provinces South Africa, to formulate an alternative bollworm (*Helicoverpa armigera *Hübner,* Earias *spp. and* Diparopsis castanea *Hampson) control strategy for small-scale farmers. Methods to increase numbers of spiders, wasps and other beneficials were evaluated in two cropping systems. Three treatments were used: untreated control, endosulfan sprayed according to thresholds and physical control (manual destruction) in both cropping systems. During weekly scouting, beneficials such as ants, various spp. of spiders, wasps, adults and juveniles of Coccinellidae and bollworms, were found. During the first season at Rustenburg, no significant differences in the bollworm, spider, ladybird and ant populations were found among treatments for the season. Significant differences were found among treatments for specific weeks. Untreated, sprayed and physical treatments on cotton-only plots had higher bollworm populations than in intercropped treatments. Spider numbers were higher intercrop plots with physical control than in other treatments. Ladybirds were higher in the sprayed and physical control treatments of the intercrop and on sprayed cotton than other treatments. Ants were more numerous on physical and untreated plots of intercrop than in other treatments. Yields were higher on sprayed plots of intercrop and cotton-only than in other treatments. The following season, significant differences among treatments were found for average bollworm numbers. Bollworm numbers were higher in untreated controls than in other treatments. Intercrop plots recorded less bollworm than non-intercrop plots. No significant differences among treatments were found for spiders and ladybirds over the season. Ladybirds only differed significantly among treatments during specific dates. They were higher in sprayed treatments and physical control treatments on cotton-only plots than in other treatments. No correlation, (except for spiders) was found between natural enemies and bollworms suggesting that other beneficials that were unaccounted for, were present in the field. There was a significantly higher yield in the untreated and sprayed treatments than in the other treatments. At Zamekomstrus, there were significant differences among treatments for ants and spider populations over the season. They were higher in untreated and sprayed plots of cotton than in other treatments. No significant differences in bollworm populations were found among treatments, irrespective of dates. There were no differences in yield between treatments.*

Introduction

Bollworms are economically important pests on cotton in South Africa (Basson, 1990). American and spiny bollworms are more important u later in the season (eight weeks post-emergence) while red bollworms become more later in the season (12 weeks post-emergence). It is therefore important that these pests be kept at as low numbers as possible for profitable production of cotton by small-scale farmers. For effective control, pesticides are usually applied, making cotton production costly. On the other hand, the efficacy of pesticides is continually reduced as pests develop resistance towards these pesticides. Furthermore, the use of pesticides presents an environmental and health risk. Dinham (1993) reported that worldwide pesticides are annually responsible for 20000 deaths and 3 million cases of acute poisoning. The people mostly affected are agricultural workers living in rural areas. Non-selective insecticides also kill beneficial insects that could have otherwise been encouraged to feed on problematic pests on cotton.

As part of the South African government's macro-economic strategy, small-scale farmers have been encouraged to grow cotton as a cash crop (Rother, 1999). These farmers are scattered all over the cotton producing areas located in the provinces, KwaZulu-Natal, Northwest Province, Northern Cape, Mpumalanga and Northern Province. In these areas, there are also potential cotton growers who only lack funding to engage in cotton production (Table 1). In 2001/2002 growing season, small-scale farmers were producing 4.5% of the national production. This is in keeping with the objective of the Cotton SA to see the contribution by small-scale sector reach 30% by the year 2005 (Louw, Cotton SA, 2001 personal communication). However, there exist factors limiting production of cotton by small-scale farmers. A major one is lack of finance to purchase agrochemicals (Pesticide Trust, 1998). Other factors are, the availability of land, and health risks associated with application of these agrochemicals.

The development of alternative production practices, which reduce the cost of production and remove the health hazards associated with the control of pests, could contribute to making cotton production more attractive to small-scale farmers.

The aim of this study was aid in developing an integrated control strategy for bollworm on cotton, which

would be suitable, economical and acceptable to the small-scale farmer. This was achieved by evaluating the suppressive effect of alternative control strategies on the bollworms and the relative impact of these control strategies on the natural enemies of bollworms.

Experimental procedure

Field experiments

All experiments were conducted in dryland cotton, *Gossypium hirsutum* intercropped with sorghum, *Sorghum bicolor* in the Northwest and Mpumalanga provinces of South Africa during October to December. Typical plot size was eight rows, 1 m apart and 10 m long, which was 80 m^2. Experiments were repeated during the two growing seasons of 2000-2002 with cotton variety Sicala and sorghum variety Pannar 8564.

Cropping systems

Two cropping systems comprising either eight rows or cotton and four rows of cotton intercropped with four rows of sorghum, were used. Cotton plants were spaced 20 cm apart and sorghum spaced 7.5 cm apart.

Treatments

The untreated control, chemical control and physical control (manual destruction) were applied on both cropping systems.

Insecticide Insecticide was applied according to field sampling, at threshold levels of five bollworms per 24 cotton plants. A commercial insecticide Thioflo (endosulfan EC, 350 g/ha) was used.

Replications Treatments were replicated four times in a complete randomized design (RBD).

Control of bollworms Plots were sampled once a week, with 12 plants observed at random. Numbers of bollworms were recorded on scouting forms, summed per replication and averaged to calculate threshold levels per treatment.

Presence of natural enemies

(i) A beating trap, made of a gray polyethylene sheet 1 m x 1 m, was used to count the spiders. It was placed between cotton rows at two different spots; five plants on each side were shaken over it. This was done once per two weeks.

(ii) A small, battery operated vacuum cleaner was used to suck up and trap other predators. Collected samples were first refrigerated and later identified under the microscope. This was also done once per two weeks.

Statistical analysis

The Genstat program was used in these experiments with a significant level of 5%.

Results and Discussion

During the first season, bollworm populations in the Northwest were less in intercropped plots than cotton-only plots (Figure 1). A similar scenario repeated itself the following season (Figures 2 to 4). Population of ladybirds was higher on cotton-only plots (Figure 5) where spraying and physical control took place as well on sprayed sorghum intercrop, than in plots where other combinations were used. This is notable by the peaks during weeks 12, 13 and 14. Population of spiders was higher in intercropped plots (Figure 6). This peaked during weeks 12 and 14.

In Mpumalanga, bollworm populations were very low and no significant differences were found among treatments. However, significant differences ($P<0.005$, Tukey test) in the average spider and ant populations were found among treatments over the season. They were higher in the untreated plots (Figures 7 and 8). Intercropping with sorghum appeared to have a positive effect as the population densities of the beneficial insects were increased (Table 1). This trend support the findings made by Krauter, Heins, Sansone and England (1998).

Yield data of the first season in Northwest province (Figure 9), indicated an increased seed cotton yield of over 3 t/ha on both cotton-only and intercropped cotton plots sprayed with endosulfan compared to other treatments. This was statistically different at 5% significance level following the Tukey test. Untreated intercropped plots had higher yields than untreated cotton-only plots, indicating bollworm control by means of natural enemies. During the second season, yields were severely reduced by jassid (*Jacobiella fascialis Jacoby*) damage. Low yields were also obtained in the Mpumalanga province. The highest yields obtained were from cotton-only and intercropped cotton sprayed with endosulfan.

References

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Table 1. *Predators identified from cotton plots intercropped with sorghum.*

Order	Family	Preferential host[1]
Hymenoptera	Mymaridae	Homoptera, Heteroptera, Lepidoptera, Coleoptera, Odonata, Psocoptera
	Eulophidae	Lepidoptera, Diptera, Coleoptera, Hemiptera, Orthoptera, Hymenoptera, Arachnida
	Braconidae	Lepidoptera
	Scelionidae	Lepidoptera, Hemiptera, Arachnida
	Eurytomidae	Polyphagous
	Cynipidae	Homoptera, Diptera
Diptera	Empididae	Diptera
	Phoridae	Lepidoptera, Coleoptera, Hymenoptera, Isoptera, Diplopoda
	Tephritidae	Polyphagous
	Platystomidae	Polyphagous

[1]According to Scholtz and Holm (1986).

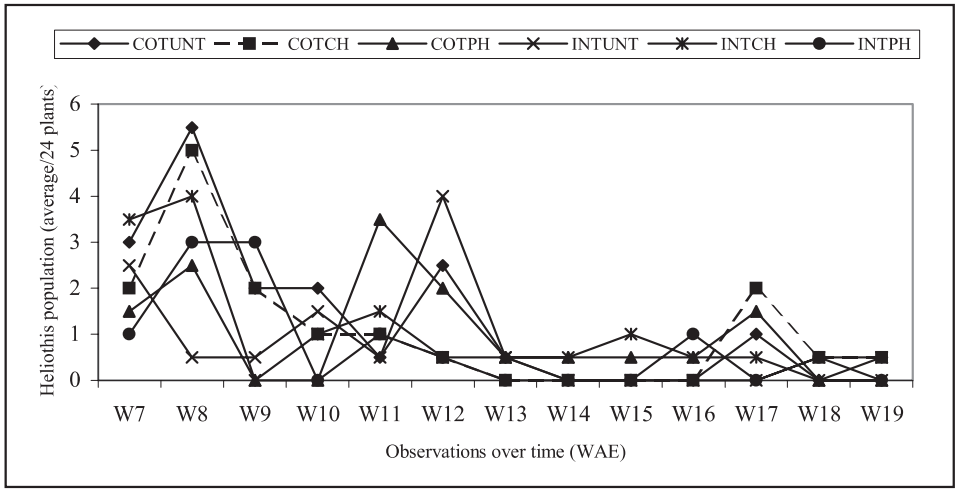

Figure 1. *Helicoverpa population for the season 2000/2001 in Northwest province*

Abbreviations:

COTUNT = cotton untreated control
COTCH = cotton plus endosulfan
COTPH = cotton plus physical control
INTUNT = intercrop untreated control
INTCH = intercrop plus endosulfan
INTPH = intercrop plus physical control
WAE = weeks after emergence

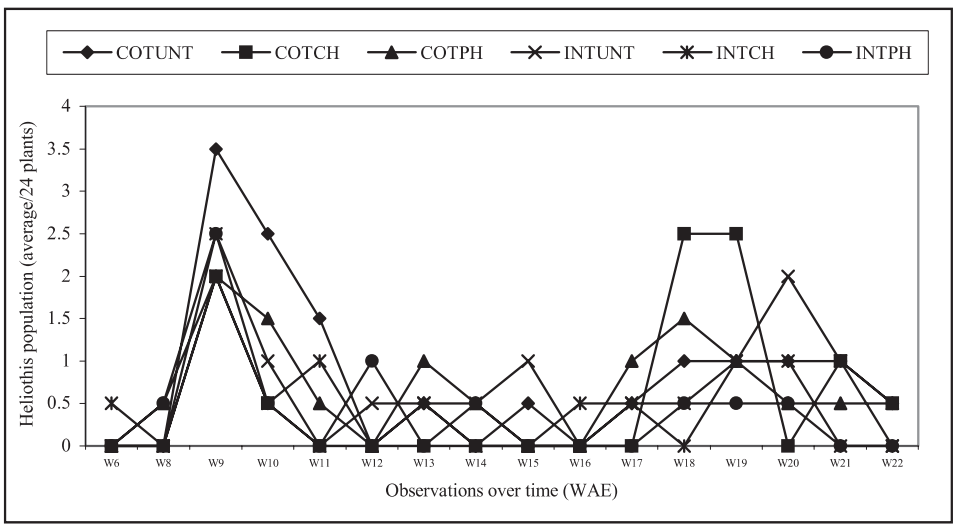

Figure 2. *Helicoverpa population for the season 2001/2002 in North West province.*

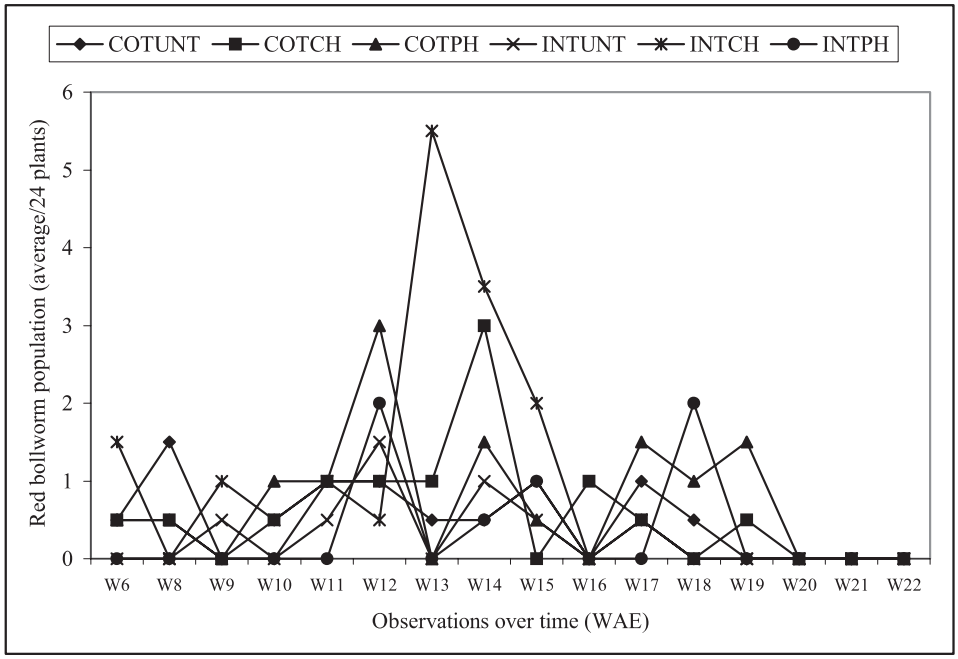

Figure 3.
Red bollworm population for season 2001/ 2002 in North West province.

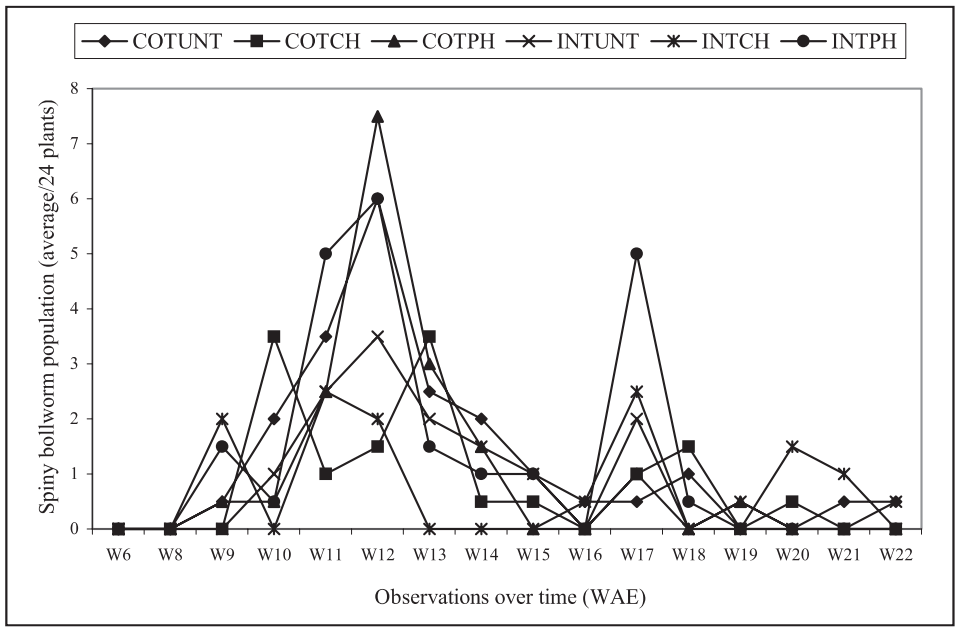

Figure 4.
Population of spiny bollworms for season 2001/2002 in Northwest province.

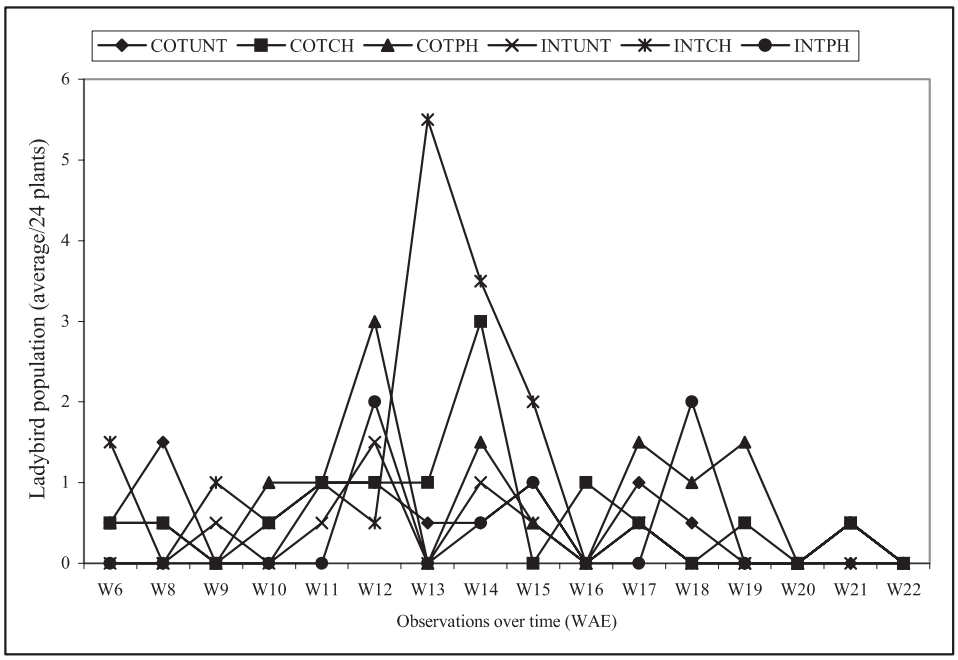

Figure 5.
Population of ladybirds for season 2001/ 2002 in North-west province.

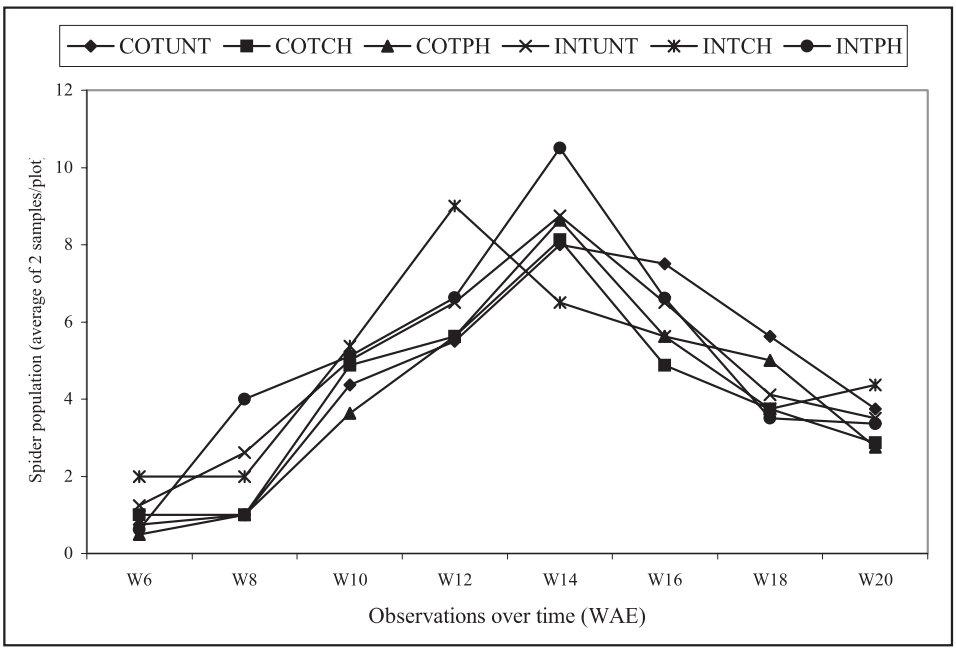

Figure 6. *Population of spiders for season 2001/ 2002 in North-west province.*

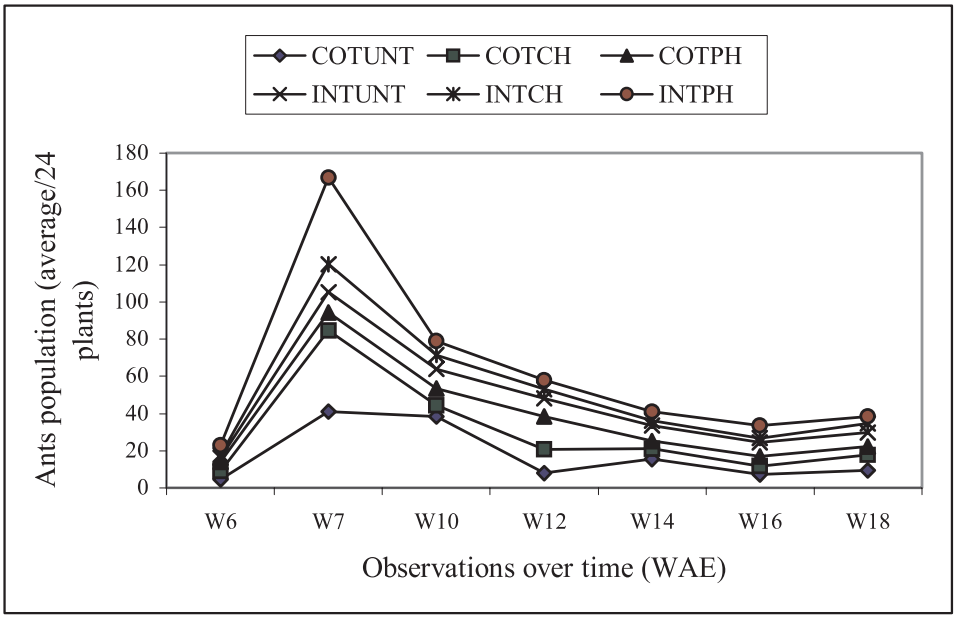

Figure 7. *Population of ants for season 2001/2002 in Mpumalanga.*

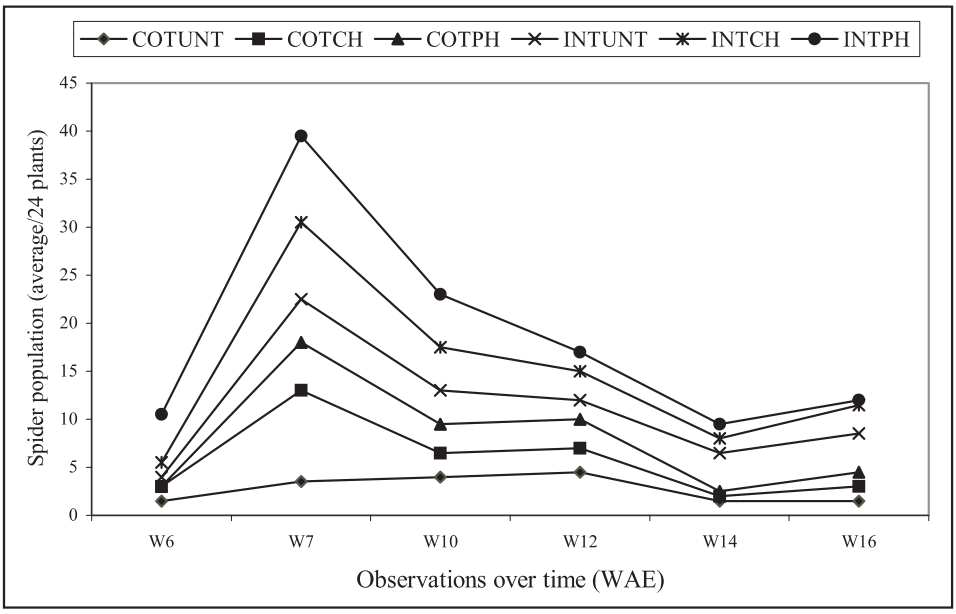

Figure 8. *Population of spiders for season 2001/ 2002 in Mpumalanga.*

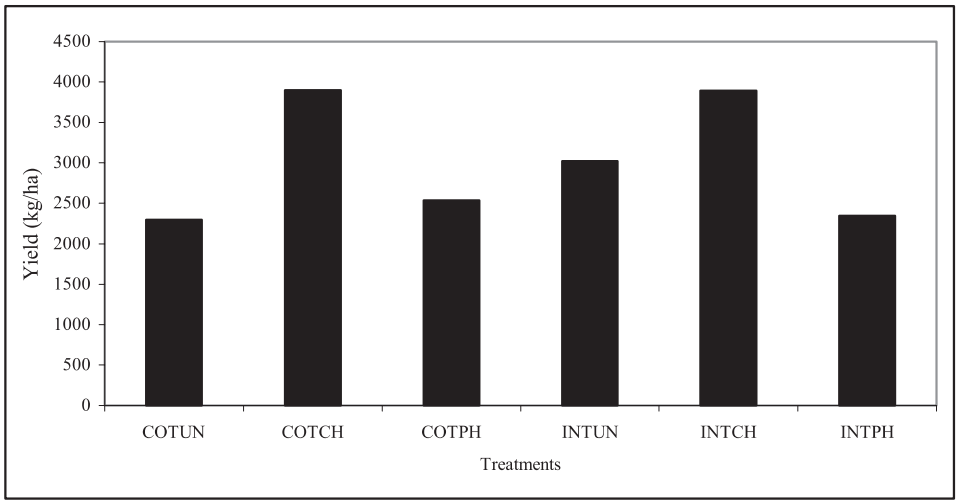

Figure 9.
Seed cotton yield of different treatments for season 2000/ 2001 in North West province.