Checkoff-Funded Research Delivering Results to Tennessee Soybean Farmers

This report, prepared jointly by the Tennessee Soybean Promotion Board, University of Tennessee Institute of Agriculture and the United Soybean Board, provides an overview of soy checkoff-supported research and extension programs. This includes projects developed and operated to help Tennessee soybean farmers address pressing issues, operate competitively and prepare for the challenges ahead. We encourage you to use the contact information about Tennessee’s soybean research and extension program.

FOR MORE INFORMATION CONTACT:
Tennessee Soybean Promotion Board
www.tnsoybeans.org

Larry R. Arrington, Chancellor
101 Morgan Hall, 2621 Morgan Circle
Knoxville TN 37996-4505
P: (865) 974-7342
F: (865) 974-8781
agriculture.tennessee.edu

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Tech Transfer is a soy checkoff program, in collaboration with state soybean boards and universities, providing research results to improve profitability of U.S. soybean farmers.

www.UnitedSoybean.org
First, let me say thanks.

Over the past 10 years, the Tennessee Soybean Promotion Board, through the checkoff program, has provided more than $3.5 million for UT AgResearch and Extension projects. Your funding, combined with funds from state and federal agencies, as well as industry, has enabled our scientists and specialists at the UT Institute of Agriculture (UTIA) to perform world-class research that has directly improved soybean production in our state.

Because checkoff-funded research is farmer-directed, these projects are focused on finding the solutions that matter to your operations and will impact your bottom line. For example, in the past 10 years, the UT Soybean Breeding Program has developed multiple new soybean lines with increased yields and improved resistance to soybean cyst nematode, stem canker and other devastating diseases. The unbiased yield data provided by the UT Soybean Variety Trials has helped producers make informed decisions when it's time to purchase seed. And we've helped combat the growing (and costly) problem of glyphosate-resistant weeds by seeking out sustainable solutions.

The information provided in this report shows how some of the research conducted by UTIA faculty and staff has benefited Tennessee soybean producers. This research has addressed areas that are of the highest priority to the state's producers, but without checkoff funding, this work could not have been accomplished.

We appreciate the support we have received from the checkoff program, and we hope to continue this mutually beneficial partnership with Tennessee soybean growers.

Dr. Larry Arrington
Chancellor, UT Institute of Agriculture

The News You Need To Know

Living in the Information Age means having instant access to the information you need. The University of Tennessee has made it possible for Tennessee farmers to quickly find the information that matters to them, with www.UTcrops.com, a one-stop website for crop managers in Tennessee. This site is a data warehouse of Integrated Pest Management (IPM) resources, variety trial information and pest identification and diagnostics. Additionally, you can print crop budgets, get weather updates and watch a soybean scout school podcast, all at one site.

In 2011, we enhanced the site by creating the UT Crops News Blog (www.news.utcrops.com). We deliver weekly and sometimes daily news updates directly to farmers through email, text alerts and Twitter. The updates include crop progress reports, pest alerts and weekly crop marketing comments. The new format also allows users to electronically ask questions of UT Extension specialists and receive quick feedback.

These resources received more than 50,000 hits in 2011 alone, proving that Tennessee farmers are making use of this tool. With continued checkoff support of Extension and AgResearch IPM efforts, we will continue to develop ways to make important soybean updates easily accessible to farmers.

Go Beans!

With the help of soy checkoff dollars, University of Tennessee specialists are now able to work one on one with a select group of soybean farmers through “GoBeans,” a soybean-verification program for Tennessee.

The program gives UT Extension specialists and county agents the opportunity to conduct on-farm research trials in a one-on-one work environment with farmers.

Each year, 10 farm locations are selected to be a part of GoBeans. Farmers choose the type of on-farm comparisons they are interested in seeing on their farms. Soil in participating fields gets sampled prior to planting and scouted weekly for weeds, insects and diseases. GoBeans also provides advice on variety selection and timing of inputs, such as foliar insecticide and fungicide products. Farmers will receive regular reports with management suggestions throughout the season.

After harvest, farmers will receive an economic analysis comparing the different programs tested in the GoBeans field. This analysis will identify where a producer could make changes in production practices in order to improve the profitability of future soybean crops.

Farmers interested in participating in GoBeans should contact their local UT Extension agent.
Soybean Scout School Goes Viral

If you want to hone your soybean-scouting skills, it’s now as easy as turning on a computer.

The University of Tennessee Institute of Agriculture has partnered with the United Soybean Board/soy checkoff and the Tennessee Soybean Promotion Board to create a Virtual Soybean Scout School. Currently the school consists of four brief video presentations, each led by UT Extension specialists, which can be viewed at www.UTcrops.com. The presentations focus on key areas of soybean scouting and include the following topics:

- Soybean Growth and Development: How to Stage Soybeans
- Identifying and Managing Weeds
- Insect Scouting
- Identifying and Managing Soybean Diseases

These classes cover much of the material presented at the traditional UT Soybean Scout Schools, which are offered at various locations throughout the state during the summer. However with the virtual format, you can attend classes on your own schedule, check in anytime for additional review and submit questions through the UT Crops News Blog.

“With this online resource, farmers and scouts now have more options when it comes to keeping informed of crop-management issues,” says Scott Stewart, Ph.D., UT Extension entomologist, “and the information is presented in a format that is easy to access on your own time.”

Virtual Soybean Scout School can be found online at www.UTcrops.com as well as at www.CTSSoybeans.org. The University of Tennessee Institute of Agriculture worked cooperatively with the United Soybean Board and the Tennessee Soybean Promotion Board using soy checkoff dollars to produce this program in order to improve the profit potential for all Tennessee soybean farmers.

Standing Guard

Researchers Use Sentinel Plots to Monitor for Soybean Rust

Since Asian soybean rust (ASR) was discovered in the U.S. in 2004, each soybean season since has seemed like a race against the clock. Can farmers harvest their crop before winds blow this devastating pathogen into Tennessee fields? Most years, the impact of soybean rust in our state is small, but if the right combination of conditions occurs, it could have a major impact on bean yield and quality.

Fortunately, the University of Tennessee, in collaboration with soy checkoff, has implemented an extra layer of protection in the form of the ASR Sentinel Program. Scattered throughout the soybean-growing areas, sentinel plots are scouted and sampled all summer, so specialists can detect soybean rust in its earliest stages.

Because of the coordinated efforts between field sampling and laboratory analysis, UT Extension specialists can provide farmers with weekly rust reports. This information helps farmers make better management decisions about when and where to spray fungicides.

The sentinel program was put to its first test in early September 2009 when experts discovered ASR in sentinel plots. UT Extension specialists quickly alerted farmers, ag industry personnel and statewide media outlets of the presence of soybean rust and the proper precautions to be taken.

Due to these efforts, rust caused no major losses that season.

With the continued support of soy checkoff dollars, the ASR Sentinel Program will continue to offer protection against this significant agricultural disease.

What Is Asian Soybean Rust?

Asian soybean rust (ASR) is a disease that causes severe defoliation of the entire soybean plant and can quickly destroy yields (up to 80 percent losses in some parts of the world!). There are many species of plants that can play host to ASR, including kudzu, winter vetch and lima beans. Currently no resistant varieties exist, and the first line of defense is the timely use of foliar fungicides. It is critical that fungicides be applied before rust infections get started.

With the help of the soy checkoff, the University of Tennessee has trained UT Extension county agents and farmers to identify soybean rust so they can react quickly and protect their crop from yield losses once rust is reconfirmed in Tennessee.
SOYBEAN BREEDING AND GENETICS

The Benefits of Good Breeding

If you want to grow the best soybeans, you have to use the best materials available, and that includes seed that can net higher yields and fight off pathogens.

Since 1975, the University of Tennessee Soybean Breeding Program has been increasing the productivity of Tennessee agriculture by introducing multiple soybean lines that are specifically developed for the growing conditions in our state. Through our breeding process, we are continually increasing yield potential and improving resistance to soybean cyst nematode populations and fungal diseases.

Conventional and glyphosate-resistant varieties developed by our program were commercially produced on more than 75,000 acres in the past three years. At a 5-bushel-per-acre estimated yield advantage, that translates to $1.25 million in additional revenue to Tennessee farmers annually. This is a direct impact of our program.

Soy checkoff funding provides crucial support to achieving our goals of improving soybean genetics.

With the continued support of soy checkoff dollars, we are committed to developing new, higher-yielding varieties for Tennessee farmers.

Poultry and livestock are every U.S. soybean farmer’s No. 1 customer. So it makes sense that plant breeders develop soybeans with animal farmers in mind.

Drs. Vince Pantalone, Andy Scaboo, Dennis West, Forbes Walker and Carl Sams contributed to the development of an independent mapping population that allows them to successfully select for a low-phytate trait in soybean breeding. Phytate is a compound commonly found in soybeans that is not easily digested by livestock like poultry and swine. Animals are typically fed diets with corn and soybean meal that naturally have high concentrations of phytate, which causes trouble with the absorption of valuable minerals like calcium, iron or potassium. This adds costs to farming operations because farmers must purchase expensive supplements to ensure their animals are healthy.

The Benefits of Good Breeding

By discovering the exact spot on the two chromosomes where the phytate genes are located, breeders now have the ability to select the trait in confidence and are better able to develop low-phytate soybeans, which will improve the availability of nutrients for animals.

One of the soybean all-stars

Soybean All-Stars

Here are a few of the top varieties released in the past 10 years. Developed by the University of Tennessee Soybean Breeding Program or through collaboration with the United States Department of Agriculture–Agricultural Research Service (USDA-ARS).

- **JTN-5203**
  This USDA-ARS and UT AgResearch joint release exhibits exceptional resistance to multiple races of soybean cyst nematode, stem canker, sudden death syndrome and frogeye leaf spot with high yield potential. It is rare and remarkable to assemble such a complete package of major disease resistance.

- **USG 75T40**
  In 2010, we released this high-yielding, glyphosate-resistant variety. In 2011, it ranked first for yield, averaged over all locations in Tennessee, producing 5 bushels per acre greater yield than the average of all varieties in its maturity class.

- **SB-01**
  This is the first soybean germplasm release that contains the two publicly available novel desaturase genes that enable the production of oil that avoids trans fats, helping meet growing demand for food with trans-fat-free oil.

- **JTN-5109 (USDA-ARS)**
  This line is effective against the most virulent soybean cyst nematode, called UX1, which overcomes the resistance of Hartwig. It will be an excellent source material for breeding high-yielding soybeans with broad resistance to nematodes.

- **USG Allen**
  A glyphosate-resistant variety that led the 2009 Tennessee State Variety Test for yield in its maturity class. Named in honor of Dr. Fred Allen, founder of UT’s breeding program.

- **USG 5002T and USG 5601T**
  These conventional varieties were developed to replace the popular Manoakin and Hutchenson varieties. A new line developed from their cross was the top-yielding entry in both the 2011 Tennessee State Variety Test and the 2011 USDA Southern Regional Test.
Getting to the Root of the Problem

According to the U.S. Department of Agriculture, the soybean cyst nematode is the most damaging soybean pest in the United States, causing estimated annual losses exceeding $1 billion. The nematode infects the roots of soybean and causes various symptoms, including chlorosis and even plant death.

Genetic resistance has been the most effective means of controlling the pest. Resistant cultivars reduce yield losses. However, over time, nematode populations have adapted to reproduce on resistant cultivars. That’s why the continued support of the UT Soybean Breeding Program is crucial — so that varieties resistant to new or different races of nematodes can be made available to farmers in a timely manner.

Transforming Tennessee Agriculture
Molecular Genetics Research Brings Traits and Improved Varieties to Farmers

The University of Tennessee (UT) Soybean Breeding and Genetics Program is an applied, field-oriented research program. In recent years the team has been successful in utilizing the tools of modern biotechnology to accelerate genetic gains and bring improved varieties to farmers more quickly. For example, UT was the first laboratory to discover genomic regions governing soybean amino acids. That effort will pay dividends as we develop new soybean varieties with improved protein quality to meet the sharply increasing demand for soybean meal. We are currently using single nucleotide polymorphism (SNP) DNA technology for transferring genes for protein, phytate, Asian rust resistance, and oleic and linolenic acid.

Working with our UT molecular genetics colleagues, microarray experiments conducted on unique lines developed by our program revealed important genes up or down regulated in response to SCN Race 2. As we gain increased understanding of this important SCN race, for which few resistant varieties exist, we will be better able to protect farmers’ soybean crops in the region.

Resist the Cyst

Soil sampling and use of resistant varieties appropriate for specific fields is critically important in soybean production. In years past, Tennessee farmers who bypassed this process may have needlessly developed new races of soybean cyst nematode (SCN).

Finding Solutions to Disease Control

UT Researchers Evaluate Resistant Varieties and Foliar Fungicides to Determine Best Disease-Management Practices

When it comes to fighting soybean pests, scientists are in agreement that the best defense is planting varieties that are resistant to disease. However, no varieties are resistant to all of the major diseases that affect Tennessee soybeans, so applying foliar fungicides gives farmers a more complete disease-management package.

Each year, a portion of your soy checkoff dollars goes toward funding variety tests and fungicide spray tests at the AgResearch and Education Center at Milan. Close to 100 commercially available varieties in four major maturity groups are planted and later sprayed with a foliar fungicide to determine the profitability of this application. As a result, farmers are able to select varieties that respond to a foliar fungicide.

Soybean farmers in Tennessee now spray 60 to 80 percent of their soybean acreage. Since realizing the value of disease control, soybean production levels have risen significantly in recent years.

Disease-Management Practices

Fungicides to Determine Best Resistant Varieties and Foliar

Resist the Cyst

Soil sampling and use of resistant varieties appropriate for specific fields is critically important in soybean production. In years past, Tennessee farmers who bypassed this process may have needlessly developed new races of soybean cyst nematode (SCN).

To help growers limit the development of additional races of SCN and give them the tools they need to manage SCN in their fields, checkoff funding was used to provide soil sampling to farmers and growers. Samples were taken from selected fields, with results and appropriate recommendations provided to growers through their local UT Extension agent.

Since this soy checkoff funded program started, nearly 200,000 acres have been sampled for SCN by the GPS units. More than half of those acres have been identified as positive for cyst nematodes. The discovery of new races of SCN existing in large areas of the state led specialists to recommend new resistant varieties and crop rotation systems. Some farmers report an increase in yields — as much as 15 bushels per acre — from using SCN-resistant varieties.

Thanks to this work, soybean farmers are able to select varieties that have disease and nematode resistance that fits their field situation. This has saved Tennessee farmers and growers about $75 per acre, or about $112 million statewide each year.
Helping Producers Pick a Winner

Tennessee farmers are faced with a lot of choices. Especially when it comes to selecting the soybean variety that will perform best on the farm. That’s why the University of Tennessee (UT) Soybean Variety Trials are so important. Each year the Agronomic Crop Variety Testing program evaluates more than 200 varieties of soybeans at AgResearch and Education Centers and on large-scale, on-farm strip tests in each physiographic region of the state.

The unbiased yield data that these tests provide help farmers make informed decisions when it’s time to purchase seed. Each year we publish our results on paper and online, so the information is accessible to everyone. And, according to surveys, a high percentage of Tennessee farmers place their confidence in UT recommendations when it comes to selecting a soybean variety.

Based on a recent survey, 92 percent of farmers and growers in six major row-crop counties in northwest Tennessee base their buying decisions on data provided in UT variety test publications. Collectively, those decisions earned them an estimated extra income of more than $12 million because they bought the higher-yielding varieties.

With the help of the soybean checkoff, UT’s variety testing program has provided soybean farmers with valuable performance data for the past five decades. And with continued support, we’ll help our farmers make the best buying decisions for many more years.

Where to Go?

You can find the latest UT Variety Trials online at www.varietytrials.tennessee.edu. For a hard copy of the results, contact your county’s UT Extension office.

PEST MANAGEMENT

Integrated Pest Management

Each year, Tennessee soy checkoff dollars are used to fund a portion of University of Tennessee’s (UT’s) Integrated Pest Management (IPM) programs. IPM is an effective and environmentally sensitive approach to pest management that relies on a combination of commonsense practices. The goal is to manage pest damage by the most economical means, and with the least possible hazard to people, property and the environment.

At the UT Institute of Agriculture, our specialists host more than 40 IPM training programs per year, including county meetings, field days and scout schools. We also conduct 40-60 research trials annually on pesticides, and we are continually evaluating sampling procedures and action thresholds.

Our efforts have led to increased confidence and adoption of recommended IPM practices, which have generated economic and environmental benefits for our state’s soybean farmers.
SOYBEAN WEED CONTROL

Weed Wars
It’s undoubtedly one of the biggest stories in agriculture right now — glyphosate-resistant weeds. And whether it’s giant ragweed, horseweed, or the dreaded Palmer pigweed, if you’ve had resistant weeds in your fields, you know how difficult it can be to stop them.

Since 2006, the soy checkoff has funded University of Tennessee (UT) efforts to manage glyphosate-resistant weeds. In the early years, those funds were used to raise awareness of the glyphosate-resistance problem, and train farmers and UT Extension agents to properly identify these weeds. Now that resistance has spread across the entire state, efforts are focused on educating farmers and growers on how to cope in this new era of weed control.

How Did This Happen?
Why are so many weeds developing resistance to glyphosate? And why is this happening now? Many researchers believe it was the overuse of glyphosate herbicide in the late 1990s–early 2000s that led to the current epidemic. That’s why we have to be careful that, as we look for solutions to this problem, we don’t create another problem. Our current research efforts are focused on finding a sustainable solution.

One effort involves looking beyond herbicides and examining cover crops like rye, crimson clover and vetch. We want to determine if these crops can provide enough cover in the winter to help suppress Palmer pigweed emergence.

In 2011 and 2012, some of these cover crops did grow enough to help provide glyphosate-resistant weed suppression, but more research is needed to get conclusive results.

We’re evaluating different non-glyphosate weed-management strategies and putting together the best management plans for farmers and growers with resistance issues.

This war on weeds is costing Tennessee farmers an estimated $200 million each year. And it’s far from over. Continued support is crucial if we are going to find a sustainable solution to glyphosate-resistant weeds.

Current Recommendations

Dr. Larry Steckel’s Tips to Managing Palmer Amaranth
• Use pre-emergence herbicide with residual control at planting.
• Follow with post-emergence herbicide over the top of 2- to 3-inch Palmer amaranth.
• Be timely: This weed can get away from you in a matter of days. Get footprints in the field and monitor for this weed.

Be Precise

UT Researchers Examine the Economic and Environmental Benefits of Precision Ag

Due to the rising cost of fertilizers, chemicals, seed, fuel and labor, Tennessee farmers are adopting precision-agriculture technologies to increase production, reduce input costs and improve profitability. At the University of Tennessee, researchers like Dr. Mike Buschermohle have implemented programs that provide technical and educational assistance to local UT Extension agents and farmers who are interested in or wish to adopt precision-agriculture technologies that are profitable and practical for their farming operation.

Thanks to the research, education and outreach efforts at the University of Tennessee, more than 400,000 acres in our state are being managed using precision agriculture technologies.

Look Mom, No Hands

Auto-steer technology (also known as auto-guidance) has taken the farming community by storm in recent years. Rising energy costs and more reasonably priced auto-guidance systems have helped justify the investment in this new technology. Early auto-guidance adapters are continuing to discover additional advantages, including reduced skips and overlaps, lower operator fatigue, ability to work in poor visibility conditions and ease of use.

It sounds good, but is auto-guidance the solution for every farm? Supported by the soy checkoff, University of Tennessee researchers are evaluating auto-guidance planting, tillage and spraying in the irregular-shaped soybean fields that make up so much of Tennessee’s agricultural landscape. This study is also comparing the Tennessee Department of Transportation’s network with competing ag dealer networks as a source of low-cost, high-precision corrections.

This research will help Tennessee soybean farmers make the best management decisions for their farm situation, potentially saving time and money, when it comes to updating technology. Thanks to support from the soy checkoff, we can experiment with new equipment and technology so farmers don’t have to commit the trials and errors on their own.
### CHECKOFF-FUNDED RESEARCH PROJECTS: 2001-2012

#### UT Extension

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<td>Determine the Effects Date of Planting Have on Yields of Groups 4 and 5 Soybean Varieties</td>
<td>Charles Graves, Wayne Flinchum, Vincent Pantalone</td>
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Fred Allen  
Robert Hayes  
Bob Williams  
Blake Brown

**Asian Soybean Rust — Training of First Detectors and Triage Personnel**  
Melvin Newman  
Alan Windham  
Steve Bost  
Darrell Hensley  
Richard Powell  
Bob Williams  
Angela Thompson  
Patricia Donald

**Monitoring Soybeans for Exotic Pests — Soybean Aphids and Rust**  
Scott Stewart  
Melvin Newman  
Angela Thompson

**Effect of Row Spacing and Population on Disease Control in Soybean with Ground Sprayers**  
Angela Thompson

**Support of Multi-County On-Farm Demonstrations of County Standardized Variety and Agronomic Test**  
Bob Williams  
Angela Thompson

### 2006

**Evaluation of Fungicide Seed Treatments on Soybean Emergence and Vigor in the Early Soybean Production System (ESPS) in Tennessee**  
Melvin Newman  
Eric Walker  
Robert Hayes  
Blake Brown

**Soybean Cyst Nematode Sampling**  
Melvin Newman  
Patricia Donald  
Prakash Arelli

**Evaluation of Soybean Cultivars for Resistance to Stem Canker**  
Melvin Newman  
Bob Williams

**Evaluations of Soybean Cultivars for Resistance to Frogeye Leaf Spot (FLS), Other Diseases, SDS and Foliar Fungicide Efficiency**  
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**Screening of Roundup Ready Soybean Varieties and Breeding Lines for Charcoal Rot, SCN and Resistance to Other Yield-Limiting Diseases**  
Melvin Newman  
Alemu Mengishu  
Pat Donald

**Soybean IPM Coordinator and Scouting Program**  
Scott Stewart  
Melvin Newman  
Russ Patrick  
Angela Thompson

**Improving Harvest Quality of Indeterminate Soybeans with Harvest Aids**  
Angela Thompson  
Larry Steckel

**Improving Spray Coverage of Foliar Fungicide Applications in Soybean**  
Angela Thompson  
Eric Walker

### 2007

**Soybean Cyst Nematode Sampling Program**  
Melvin Newman  
Patricia Donald  
Prakash Arelli

**Combined Evaluations of Soybean Cultivars for Resistance to FLS, Other Diseases, Sudden Death Syndrome (SDS), Stem Canker, and Foliar Fungicide Efficacy**  
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- **Support of Multi-County On-Farm Demonstrations of County Standardized Variety and Agronomic Test**
  - Bob Williams

- **Searchable Database for UT Soybean Information**
  - Angela Thompson
  - Fred Allen
  - John Toman

### 2008
- **Soybean Cyst Nematode Sampling and Advisory Program**
  - Melvin Newman
  - Patricia Donald
  - Prakash Arelli

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  - Melvin Newman
  - Bob Williams
  - Blake Brown

- **Asian Soybean Rust Training of First Detectors and Triage Personnel**
  - Melvin Newman
  - Bob Williams

- **Support of Multi-County On-Farm Demonstrations of County Standardized Variety and Agronomic Test**
  - Bob Williams

- **Support of Extension and Research IPM Efforts**
  - Scott Stewart

### 2009
- **Maturity Group and Seeding Rate Combinations for Double Crop Soybeans to Maximize Yield and Minimize Charcoal Rot Incidence**
  - Angela T. McClure
  - Eric Walker
  - Alemu Mengistu

- **Printing Weed Control Support Manual**
  - Larry Steckel

- **Research and Extension Support for Management of Glyphosate-Resistant Weeds**
  - Larry Steckel
  - Tom Mueller
  - Angela T. McClure

- **Combined Evaluation of Soybean Cultivars for Resistance to Frogeye Leaf Spot, Other Foliar Diseases, Sudden Death Syndrome, Stem Canker, and Foliar Fungicide Efficacy**
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Thomas Mueller

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<td>Neal Stewart, Matthew Halfhill, Kurt Lamour, Vincent Pantalone</td>
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