PATRIOT CRAWL SPACE REPAIRS · TECHNICAL PAPER

CRAWL SPACE SCIENCE

Crawl Space Mold Treatment vs. Mold Removal

Why borate fungus treatments leave the mold on the wood, what the manufacturer and the USDA say about moisture, and what actually keeps crawl space mold from returning in the coastal Southeast.

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Treated, not removed. Floor framing in a Hampton Roads crawl space after two coats of borate fungicide. The growth is still on the wood.

Summary

Homeowners in the coastal Southeast routinely pay for crawl space "mold treatments" or "fungus treatments" and find the same growth on the framing the following summer. This paper explains why. A chemical treatment sprays a borate fungicide that may kill or suppress fungal growth; it does not remove the fungal material from the wood. Mold removal physically cleans the contamination off accessible surfaces and replaces materials that cannot be cleaned. Neither corrects the moisture that allowed the growth.

The paper draws on EPA guidance, the USDA Forest Products Laboratory's *Wood Handbook*, the manufacturer's own technical bulletin for the most common borate products, HUD-funded field research by Advanced Energy and Duke University, and the author's field observations from more than 600 crawl space inspections a year.

Key findings

- EPA: dead mold can still cause allergic reactions; killing it is not enough, it must be removed.
- Borate treatments (Tim-bor, Bora-Care, Bora-Care with Mold-Care) are labeled as wood preservatives against decay fungi and insects. They are not a cleaning method.
- The manufacturer states that moisture is the key to fungal control, that all moisture problems should be fully rectified, and that no product can permanently protect a structure that remains continuously wet.
- USDA FPL: borates are "readily soluble in water and highly leachable" and should be used only where wood is protected from wetting.
- In HUD-funded field research, 62% of 45 vented North Carolina crawl spaces had visible mold and 67% had wood moisture high enough to support growth. Summer humidity readings were at or above 70% RH nearly 100% of the time.
- In the author's experience, growth returns within 6 to 12 months when a damp crawl space is treated without correcting moisture.
- Physical removal with a 17% hydrogen peroxide cleaner and hand-wiping, followed by moisture control that holds wood moisture at or below 16%, prevents recurrence without ongoing fungicide application.

1. Treatment, removal, and moisture control

Three different services are sold under the heading of "crawl space mold," and the estimates homeowners receive rarely say which one they are buying.

Mold treatment / fungus treatment. A chemical, usually a borate solution, is sprayed on the framing to kill or suppress fungal growth. The existing fungal material stays on the wood.

Mold removal. Fungal contamination is physically cleaned off the framing and other accessible solid surfaces. Materials that cannot be cleaned, such as contaminated fiberglass insulation and fibrous duct liner, are removed and replaced.

Moisture control. The conditions that allowed growth are corrected: outside air is kept out, ground moisture is controlled, and the crawl space is supplied with dry air. Without this step, both of the above are temporary.

The simplest way to see the difference is a shower that has not been cleaned in ten years. If a contractor sprays the tile with a chemical and leaves the mold and mildew in place, the homeowner would not accept "I treated it" as a completed job. The same standard applies under the house.



Figure 1. Left: framing after two coats of borate fungicide, growth still present. Right: framing after physical cleaning. Some water staining remains; staining alone does not indicate active growth. Photos: Patriot Crawl Space Repairs.

2. Why physical removal matters

Killing mold does not eliminate its potential health effects. The EPA's homeowner guidance is explicit on the point:

> *"Dead mold may still cause allergic reactions in some people, so it is not enough to simply kill the mold, it must also be removed."*
>
> EPA, A Brief Guide to Mold, Moisture and Your Home, p. 15 [1]

Mold spores and fungal fragments become airborne when contaminated material is disturbed, and those particles are not confined to the crawl space. In HUD-funded research, Duke University and Advanced Energy documented fungal spores moving from crawl spaces into living areas through openings in the floor and leakage in HVAC systems [4].

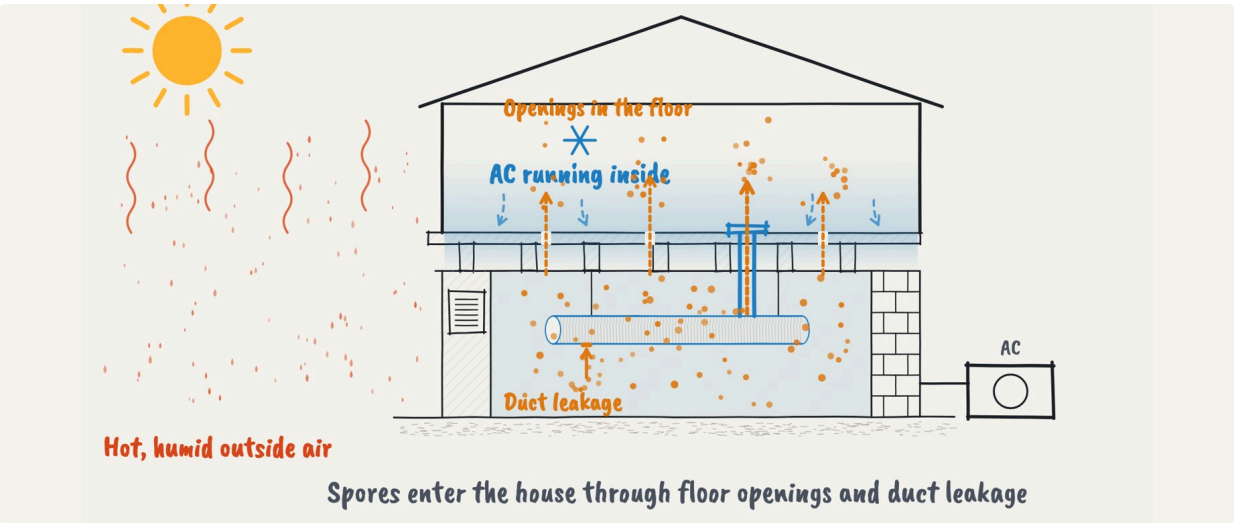


Figure 2. Pathways from a vented crawl space into the living space: plumbing and wiring penetrations through the subfloor, and leakage at duct joints that pulls crawl space air into the supply system.

Because different people are sensitive to different fungi, and crawl spaces commonly contain a mixture of species, the relevant questions are the extent of the contamination, whether the affected material can be cleaned, and whether the moisture conditions have been corrected. Identifying the species on each joist does not change the work.

3. Prevalence in Southeast crawl spaces

In 2005, Advanced Energy investigated 45 vented crawl spaces in North Carolina as part of a larger Duke University study funded by HUD [4]. The findings describe the baseline condition of a vented crawl space in this climate.

Measure	Result
Crawl spaces with visible mold	**62%**
Crawl spaces with wood moisture capable of supporting mold growth	**67%**
June–July humidity readings at or above 70% RH	**100%**
August humidity readings at or above 70% RH	**99%**

The mechanism is not in dispute. Warm, humid outside air enters the cooler crawl space through foundation vents. Relative humidity rises, and water condenses on surfaces that sit below the dew point: supply ducts, and framing chilled from above by the air-conditioned house. The manufacturer of the most common borate treatments gives the thresholds: fungal growth requires wood above **20%** moisture content or air above **80%** relative humidity [3]. A vented coastal crawl space in July meets those conditions for weeks at a time.

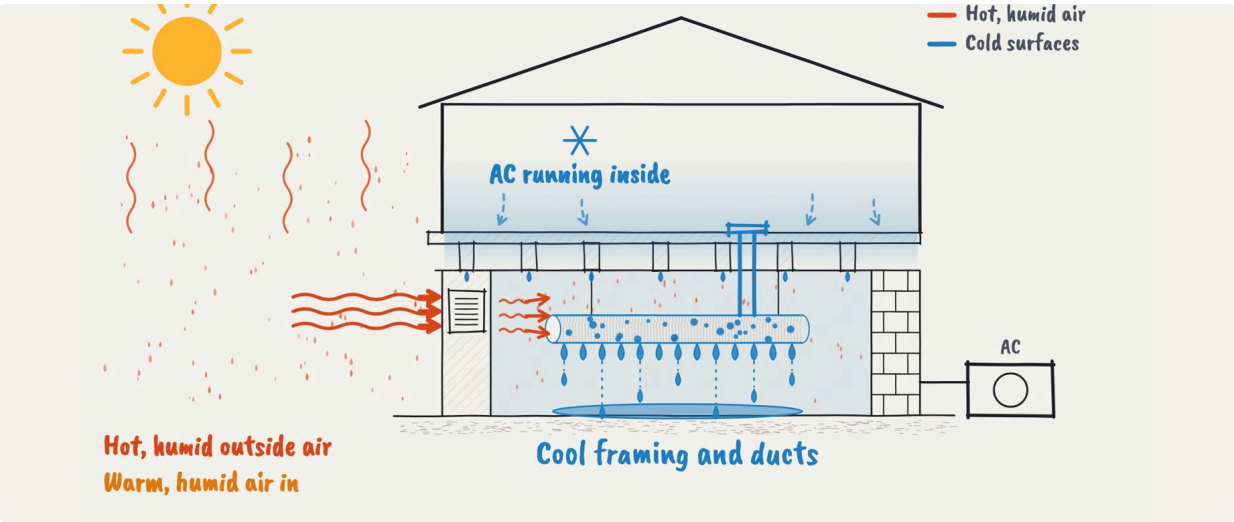


Figure 3. Humid outside air entering a vented crawl space, condensing on cool ductwork and framing. Red: hot, humid outside air. Blue: cold surfaces and condensation.

4. What borate treatments are

The three products most often applied as crawl space "fungus treatments" in this market are Tim-bor Professional, Bora-Care, and Bora-Care with Mold-Care. All three are manufactured or distributed by Nisus Corporation and share the same active ingredient, disodium octaborate tetrahydrate. Bora-Care adds a glycol carrier to improve penetration; Bora-Care with Mold-Care adds a quaternary ammonium biocide intended to kill active mold.

These are legitimate products with legitimate uses. The Tim-bor label describes it as "a preservative for protection and treatment of wood against fungal decay and wood destroying insects including termites." Borates are listed in AWPA standards for protected applications such as framing lumber, and they are widely used in new construction, for preventive protection, and as a remedial treatment on existing structures [2].

What the labels do not describe is a method for cleaning mold off framing. A borate treatment leaves the existing fungal material in place and depends on the wood staying dry enough that new growth does not establish. In a vented coastal crawl space, that second condition is not met.

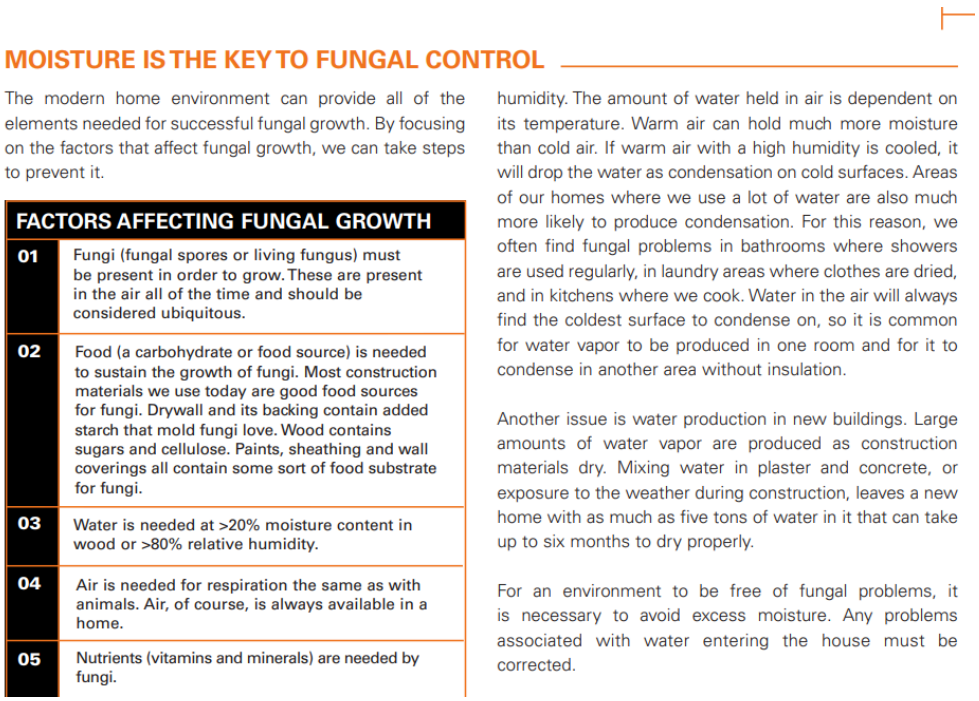


Figure 4. Tim-bor Professional, Bora-Care, and Bora-Care with Mold-Care. Wood preservatives, not a cleaning method.

5. What the manufacturer says

Nisus Corporation's *Mold and Fungi Technical Bulletin* (2020) is the manufacturer's own guidance to applicators [3]. Its treatment of moisture is direct, and it supports the position of this paper on every point that matters.

The bulletin's discussion of fungal growth opens under the heading **"Moisture Is the Key to Fungal Control,"** lists water as one of five requirements for fungal growth, and quantifies it: water is needed at greater than 20% moisture content in wood or greater than 80% relative humidity. It closes the section with: "For an environment to be free of fungal problems, it is necessary to avoid excess moisture. Any problems associated with water entering the house must be corrected."



MOISTURE IS THE KEY TO FUNGAL CONTROL

The modern home environment can provide all of the elements needed for successful fungal growth. By focusing on the factors that affect fungal growth, we can take steps to prevent it.

FACTORS AFFECTING FUNGAL GROWTH	
01	Fungi (fungal spores or living fungus) must be present in order to grow. These are present in the air all of the time and should be considered ubiquitous.
02	Food (a carbohydrate or food source) is needed to sustain the growth of fungi. Most construction materials we use today are good food sources for fungi. Drywall and its backing contain added starch that mold fungi love. Wood contains sugars and cellulose. Paints, sheathing and wall coverings all contain some sort of food substrate for fungi.
03	Water is needed at >20% moisture content in wood or >80% relative humidity.
04	Air is needed for respiration the same as with animals. Air, of course, is always available in a home.
05	Nutrients (vitamins and minerals) are needed by fungi.

humidity. The amount of water held in air is dependent on its temperature. Warm air can hold much more moisture than cold air. If warm air with a high humidity is cooled, it will drop the water as condensation on cold surfaces. Areas of our homes where we use a lot of water are also much more likely to produce condensation. For this reason, we often find fungal problems in bathrooms where showers are used regularly, in laundry areas where clothes are dried, and in kitchens where we cook. Water in the air will always find the coldest surface to condense on, so it is common for water vapor to be produced in one room and for it to condense in another area without insulation.

Another issue is water production in new buildings. Large amounts of water vapor are produced as construction materials dry. Mixing water in plaster and concrete, or exposure to the weather during construction, leaves a new home with as much as five tons of water in it that can take up to six months to dry properly.

For an environment to be free of fungal problems, it is necessary to avoid excess moisture. Any problems associated with water entering the house must be corrected.

Figure 5. Nisus Corporation, Mold and Fungi Technical Bulletin (2020): "Moisture Is the Key to Fungal Control" and the factors affecting fungal growth.

The bulletin does identify a legitimate role for chemical treatment: protecting wet building materials while they dry, a process that "may take weeks or months." After flooding or a serious water intrusion, that is a reasonable use.

But under **Post-Construction Treatments Using Bora-Care with Mold-Care** (page 6), the manufacturer directs applicators that "all moisture problems should be fully rectified," and that the applicator should "properly dry out the structure." And on page

7, under Customer Communication:

> *"It is not possible for any product to provide permanent protection of a structure that remains continuously wet."*
>
> Nisus Corporation, Mold and Fungi Technical Bulletin, 2020, p. 7 [3]



POST-CONSTRUCTION TREATMENTS USING BORA-CARE WITH MOLD-CARE

Homes or buildings with fungal problems should first be fully inspected and surveyed by a qualified professional for both the extent of fungal damage or colonization and the source of moisture. This may involve removal of dry wall and insulation. Such disruption can stir up or release fungal spores. To avoid any potential allergies, appropriate respirators should be used, and the homeowners should be advised that there may be a higher level of fungal spores in the air for a number of days after the work is complete. In severe situations, the advice of an industrial hygienist should be sought and a full site containment and mold remediation may be necessary.

Any structural defects must be repaired as a matter of urgency to protect the building from failure. All moisture problems should be fully rectified, and this may include the repair of the building to prevent rising and penetrating damp and/or the installation of appropriate ventilation. Education of the homeowner as to the cause and source of the problem is an important step to prevent reoccurrence.

Areas showing any signs of fungal or insect activity or any signs of dampness (use a moisture meter and moisture analysis rather than by eye for actual moisture content) should be properly treated with a combined application of Bora-Care with Mold-Care.

Properly dry out the structure, if necessary leaving off drywall or adding additional electric heating, ventilation and/or dehumidification. Kerosene and propane heaters should not be used as they produce a great deal of water as part of the combustion.

Treating a subfloor controls mold and prevents dry rot and insect infestation that also accompany moisture problems.

Use a drill and impeller to mix Bora-Care with Mold-Care

CUSTOMER COMMUNICATION

It is not possible for any product to provide permanent protection of a structure that remains continuously wet. It is important to talk to the builder/contractor and if possible to the homeowner to explain the treatment and educate them on conducive conditions that will cause mold, decay and insect infestation. It is also important for the pest management professional to do a thorough onsite annual inspection to determine if any conducive conditions exist.

Any product is only as good as the application, and as a pest management professional we hope you will use this information to protect you, your company and most importantly the homeowner from the results of mold and pest infestation.

DOCUMENTATION

It is important to graph the structure and fully document the Bora-Care with Mold-Care application. This documentation will be an important tool for future inspections.

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Figure 6. Nisus bulletin, pages 6 and 7: moisture problems are to be fully rectified; no product permanently protects wood that stays wet.

6. Borates and liquid water

Borates are water-soluble salts. That property is why they penetrate wet wood well and why they are useful as a remedial treatment. It is also why they do not stay put. The USDA Forest Products Laboratory's *Wood Handbook* states it without qualification:

> *"Borate preservatives are readily soluble in water and highly leachable and should be used only above ground where the wood is protected from wetting."*
>
> USDA Forest Products Laboratory, Wood Handbook, Chapter 15, p. 15-5 [2]

On spray-applied borates specifically, the same chapter notes that "because they are not fixed to the wood they can be leached during subsequent precipitation" (p. 15-19). In a crawl space the liquid water is condensation rather than rain, but the mechanism is the same: water moves through the wood and carries dissolved borate with it.

Inorganic Boron (Sodium Borates–Boric Acid)

Borate preservatives are readily soluble in water and highly leachable and should be used only above ground where the wood is protected from wetting. When used above ground and protected from wetting, this preservative is very effective against decay, termites, beetles, and carpenter ants. Inorganic boron (SBX) is listed in AWPA standards for protected applications such as framing lumber. The solid or treating solution for borate preservatives (borates) should be greater than 98% pure, on an anhydrous basis (AWPA P25). Acceptable borate compounds are sodium octaborate, sodium tetraborate, sodium pentaborate, and boric acid. These compounds are derived from the mineral sodium borate, which is the same material used in laundry additives.

In addition to pressure treatments, borates are commonly sprayed, brushed, or injected to treat wood in existing structures. They will diffuse into wood that is wet, so these preservatives are often used as a remedial treatment. Borates are widely used for log homes, natural wood finishes, and hardwood pallets.

Figure 7. Wood Handbook, Chapter 15, Inorganic Boron: readily soluble, highly leachable, for use only where protected from wetting.

Ordinary humidity does not wash a treatment away overnight. Repeated liquid-water exposure is the direct leaching mechanism. But a crawl space that condenses water on the framing every summer provides exactly that exposure, year after year, and the treatment's protection declines while the moisture that caused the growth continues.

7. Field observations

The author personally inspects more than 600 crawl spaces a year in Hampton Roads, Virginia, and has been involved in building, renovating, inspecting, and selling hundreds of homes over several decades.

When a damp Southeast crawl space receives a fungus treatment without moisture correction, growth commonly returns within six months to a year. The author has documented recurrence after two coats of fungicide (Figure 1, left). The pattern is consistent: the chemical suppresses growth temporarily, the conditions responsible for the growth never change, and the growth returns.

The converse holds as well. Crawl spaces the company cleaned years earlier, where the moisture control was maintained, have not developed new growth, and no additional fungicide was applied.

8. Physical removal protocol

Patriot's removal protocol starts with YCS Pro Cleaner, a professional hydrogen peroxide-based cleaning solution. The concentrate is **17%** hydrogen peroxide, compared with about 3% in ordinary household peroxide [5]. Peroxide was selected because it produces no harsh gases or odors in a confined space and is effective on organic contamination.

The cleaner is applied to the framing and allowed 30 to 60 minutes of dwell time per the product's application requirements. Technicians then hand-wipe the remaining fungal material from the wood. The result is framing that looks close to new. Some water staining or discoloration may remain; staining alone does not indicate active mold.



Figure 8. Left: hand-wiping framing after peroxide dwell. Right: cleaned framing with residual staining.

What can be cleaned and what must be replaced

Material	Disposition
Wood framing, structurally sound	Clean
Other solid, accessible surfaces	Clean
Metal ductwork, contamination accessible	Clean
Fiberglass insulation, significantly contaminated	**Remove and replace**
Fibrous duct liner, significantly contaminated	**Remove and replace**

Fungal contamination cannot be wiped out of fibrous materials the way it can be removed from exposed lumber. When fiberglass insulation or fibrous duct liner is significantly contaminated, removal and replacement is the appropriate course.



Figure 9. Materials that are replaced rather than cleaned: contaminated fiberglass insulation (left) and fibrous duct liner inside a torn jacket (right).

Scope

Not every crawl space with mold requires an expensive cleaning. Where significant fungal growth is present, cleaning is required as part of the remediation project; the company will not leave substantial contamination behind under its name. Where growth is minor, the options are explained and the homeowner decides. Where there is barely any visible growth, an expensive cleaning is not warranted. The goal is not a sterile crawl space, which is impossible, but the removal of meaningful contamination, correction of the moisture conditions, and prevention of new growth.

9. Cost

For a typical 1,500-square-foot crawl space in the Hampton Roads market, a chemical-only fungus treatment might cost around **$1,200**. Physical mold cleaning typically costs around **$2,800**.

The difference is labor, not technology. Physically cleaning framing in a two-foot-high crawl space, working around ductwork, plumbing, piers, and other obstructions, is slow, hard work. Spraying a chemical is substantially easier than removing the contamination. The two are different services, and an estimate should say which one it is for.

Service	Typical cost, 1,500 sq ft	What the homeowner gets
Chemical-only fungus treatment	**~$1,200**	Growth suppressed; fungal material remains on the wood
Physical mold cleaning	**~$2,800**	Fungal material removed from framing; contaminated fibrous materials replaced
Moisture control	Separate scope	Conditions corrected so growth does not return

10. Bleach and testing

Bleach

Bleach is the first thing many homeowners reach for. The EPA does not recommend bleach or other biocides as a routine part of mold cleanup; the goal is to remove the mold, not just kill it [1]. The same guidance notes that remaining spores "will not grow if the moisture problem has been resolved." Like any other chemical, bleach does nothing about the moisture that caused the growth.

Testing

When mold is plainly visible, laboratory testing rarely changes the work. The EPA's guidance: "In most cases, if visible mold growth is present, sampling is unnecessary" [1]. An ordinary airborne particle counter does not identify mold; it counts particles that may be dust, pollen, fibers, or other material.

Testing is useful when contamination is hidden, the source is uncertain, or a specialized investigation is warranted. When the problem is visible, the homeowner needs an inspection and a corrective plan, not a test to confirm what can already be seen.

11. Moisture control and verification

What keeps crawl space mold from returning is moisture control. In the coastal Southeast that means managing groundwater where necessary, sealing the foundation vents, installing a ground vapor barrier, and providing a reliable drying mechanism.

Depending on the house, the drying mechanism is either conditioned supply air from the HVAC system or a dedicated dehumidifier.

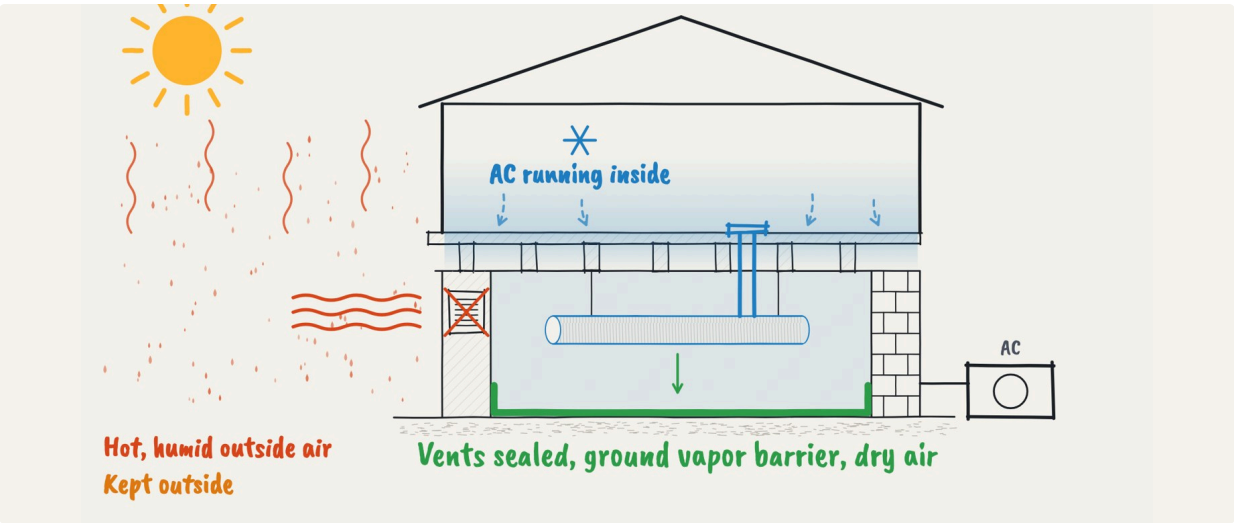


Figure 10. The corrected crawl space: vents sealed, ground vapor barrier installed, dry air supplied. Green: the fix.

The system is then verified by monitoring wood moisture content. In properly controlled crawl spaces, Patriot typically records average wood moisture around **11%**, with summer highs of 13 to 15%. The target is **16%** or below, even during the worst of the humid summer. That is well under the 20% threshold the manufacturer identifies for fungal growth.



Figure 11. Left: dedicated dehumidifier in a finished crawl space. Right: wood moisture reading of 10.5% on framing in a controlled crawl space.

When those conditions are maintained, properly cleaned framing does not develop new growth, and no additional fungicide is applied. The strategy is no longer chemical suppression; it is maintaining conditions that do not support growth.

12. Homeowner checklist

When comparing crawl space estimates, ask every contractor four questions.

1. Are they physically cleaning the framing, or just spraying it?
2. What happens to contaminated insulation or ductwork?
3. How will they keep the crawl space dry in July and August?
4. Will they measure the wood moisture afterward to prove it is working?

A contractor who cannot give clear answers is most likely proposing a treatment, not a remediation.

13. Conclusion

A chemical treatment suppresses mold. Cleaning removes it. Moisture control keeps it from coming back.

A $1,200 fungus treatment and a $2,800 mold cleaning are not the same service, and neither one replaces proper moisture control. The manufacturer of the treatment products, the USDA Forest Products Laboratory, and the EPA all say the same thing in their own words: correct the moisture, and remove the mold. A crawl space program that does both does not need to rely on chemicals to keep fungal growth down. It maintains conditions under which the growth does not occur.

References

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[2] Kirker, G.T., and Lebow, S.T. 2021. "Wood Preservatives." Chapter 15 in *Wood Handbook: Wood as an Engineering Material.* General Technical Report FPL-GTR-282. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. research.fs.usda.gov/fpl/wood-handbook

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[4] Advanced Energy and Duke University. 2005. HUD-funded field study of 45 vented crawl spaces in North Carolina: visible mold, wood moisture, summer humidity, and spore transport into living areas. advancedenergy.org

[5] Your Crawlspace. *YCS Pro Cleaner* product sheet (17% peroxide concentration). yourcrawlspace.com

About the author



Robbie McCarty is the owner of Patriot Crawl Space Repairs in Hampton Roads, Virginia. He personally inspects more than 600 crawl spaces a year and has been involved in building, renovating, inspecting, and selling hundreds of homes across roughly three decades in Virginia construction and real estate. He holds a Virginia Class A contractor's license, a master plumber license, a licensed pest control operator credential, and MICRO certification as a mold remediation contractor.

His company specializes in structural repair, mold remediation, and moisture control in the hot, humid coastal Southeast. His Crawl Space Science video series and technical papers document what works, and what does not, in this climate.

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