News From...
ADVANCING ECO-AGRICULTURE
July 2010
Connecting the Missing Links for Full Potential Agriculture

Maximizing Genetic Potential

In conversations with plant geneticists, plant breeders and other researchers, we can learn that on average most crops yield only between 25 and 40 percent of the seed's full potential, which several farmers can bear witness to. How else can we explain some of the record yields of commodity crops such as corn and beans? Why aren't more farmers producing crops with this level of production?

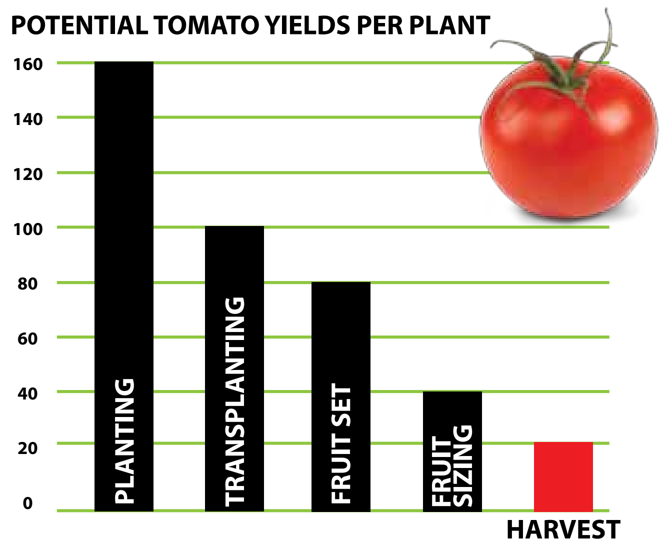
The answer to this question is at once absurdly simple and amazingly complex. It is called stress. The simplicity of this answer is perhaps at once apparent, but let's take a closer look at different stress potentials and their affect on crop health and production.

There are obviously many different potential sources of stress, for example moisture stress, temperature extremes, nutritional deficiencies, lack of sunshine, pest pressure, etc. Let's take a walk through a plant's growth cycle and examine some common potential stress factors in crop production.

It has been my experience that any stress potential has a potential impact which increases geometrically as the plant's size is reduced or, stated in a more straightforward manner, "the younger the plant is when it is exposed to stress the more of an impact on final yield and production the stress will have". It is perhaps easier for us to recognize this principle when we are working with animals. It is not that difficult for us to see how a young animal which has once been stressed and stunted, never reaches its full potential.

Along the same lines, the stress potentials which have the biggest impact on future production influence the plant while it is still small. The first weeks and months of growing are absolutely critical in determining the realization of the seed's potential. Any conditions less than ideal at planting are unacceptable.

Join us on the
Farmer Conference Call
See page 4 for details



I imagine a seed genetic potential as being displayed on a bar graph where we have the total production potential only at the day of planting. From this point forward, the yield potential will decline until we reach the day of harvest. So the reality is the fertilizers we use and the water we irrigate with is not really increasing yields, they are preventing that yield from being lost because of stress.

Transplanting

The first major stress potential is at planting or transplanting in the field. It is critical to have high quality transplants when we go to the field to enable them to get off to a healthy, vigorous start.

I would define a high quality transplants as a plant which has had minimal amounts of stress in the greenhouse and has had balanced and adequate levels of mineral nutrition, which is absolutely essential for producing high quality transplants without stress.

Most commercial greenhouse programs provide more than adequate amounts of nitrogen which can lead to plants with weak watery cells, which equates to soft stems and leaves. These plants will need to harden off (a stress factor) before planting or they will suffer from transplant shock. By contrast, if plants are grown with other minerals such as calcium, phosphorus, potassium, magnesium and others in equilibrium with nitrogen, we can produce transplants without the soft cells which lose moisture readily, plants that can be taken directly to the field.

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Fruit Set

At this stage of plant growth, plants undergo a dramatic hormone shift as they enter the reproductive cycle. Any nutritional discrepancies are amplified at this point, especially the trace minerals since all of these minerals are heavily involved as enzyme cofactors and in other roles during this transition.

This is an especially important stage in perennial crops, which often flower and fruit all at one time. If the essential mineral cofactors are not present in adequate quantities, this can quickly flip a crop into proteolysis as documented by Francis Choubousan in "Healthy Crops"*.

Fruit Sizing

The third critical stage of plant growth is fruit sizing. At this stage, a tremendous amount of yield potential is frequently lost because of the soil's dysfunctional digestive system.

As plants begin to size fruit, they begin to absorb a tremendous amount of mineral nutrition in an effort to provide enough nutrients and other compounds to fill as many fruit as possible to the maximum capacity. If they can access adequate amounts of mineral nutrition the results can be outstanding but this is frequently not the case. Why is this?

From my perspective, the answer does not appear to be that the soil contains inadequate minerals in most cases. The minerals might be there but in an unavailable, locked up form. The primary problem appears to be the soil's digestive capacity.

Many of us are aware of the interactions between the microbial population in the rhizosphere and on the phylloplane and their plant symbionts. These microbial communities perform the role of digesting many mineral and organic compounds and making them plant available, strikingly similar to a ruminant digestive system or even to our own.

The scenario which frequently occurs in the field, however, is that come midsummer the plants have already absorbed a great deal of the nutrients which have been released from a subpar digestive system over the recent weeks and months.

Now suddenly the plants' nutrient requirements escalate intensely as they begin to fill fruit. At the same time, the plant has such heavy demands, the plants' primary digestive tract, otherwise known as the rhizosphere, is on a slippery, downhill slope for a variety of reasons such as low levels of soil carbon, inadequate moisture, being depressed by poor quality irrigation water, not enough soil oxygen, etc.

Without adequate nutrients, the plant simply begins to shutdown. It will discontinue to set fruit, may even abort some fruit which has already set, and will put less food into each individual fruit, which will result in less fruit, lower overall fruit quality, and significant loss of genetic potential.

- JK

AEA Consultants:

Dave DeVries *(Canada)*	519-503-2523
Tim Kimpel *(Ohio)*	740-697-0230
Dan Kittredge *(Mass.)*	978-257-2627
Mark Klish *(Wisconsin)*	715-366-7671
Dave Kunkle *(New York)*	585-476-2262
David Miller *(Ohio)*	740-623-0989
Charles Miller *(Iowa)*	319-683-3925
Douglas Piltingsrud *(Minnesota)*	507-272-9050
Lonnie Slaubagh *(Kentucky)*	606-763-6117
Tim Wightman *(Ohio)*	937-692-8453
Sam Zook *(Penna.)*	717-354-2115

Greetings to our friends and food producers...

It is a pleasant evening in early June as I am writing this. We have had a good spring here on the farm for the most part. We had quite a dry spell in April, but that has been followed by more than adequate rains in May and early June. Right now there is standing water in the fields but I don't expect it to last too long this time of year.

Several years ago I picked up a short four word phrase at a biological farming seminar which carries many profound implications for us as food producers:

"Environment determines genetic expression"

I fear it is too easy for many of us to accept this statement at face value and not really realize all the profound implications carried by this potent phrase. If we take some time to think about it, we can see this holds true for all manners of living organisms, whether it be the smallest microbes such as bacteria and fungi or much larger life forms, including all species of plants and animals. This has become a research topic styled 'epi-genetics' in which there has been a lot of interest expressed recently. Again, "environment determines genetic expression".

I believe in order for us to really enjoy working with plants in the field, we may need to change some of our base paradigms (thought patterns – preconceived ideas) which prevent us from clearly seeing the true picture of how environment influences genetic expression and production.

As an example of how our thought processes can color our perspective, let's take a look at the roles played by what we term 'pathogenic' microbes, such as blights and mildews.

Frequently, when we view a diseased plant we might think, "This plant is sick because of the disease which has attacked it." When the reality of the situation is the disease attacked the plant because it was unhealthy. This same principle holds true for all organized systems whether they be plant, animal, or man. If the system is dysfunctional because of environmental imbalance we become "dis-eased".

As an analogy to the picture just painted, let's review the role played by an insect we are all familiar with – the mosquito.

As we know, mosquito larvae are found in still, stagnant water such as in pools, puddles, and swampy areas, but are generally not found in moving fresh water such as rivers and streams. So according to the conventional theory of dis-ease, the mosquito larvae are responsible for causing the stagnant water! If we could somehow eliminate the mosquito larvae, the stagnant water would correct itself.

We can see how illogical this appears and yet this is exactly the thought process we use when we think of plant pathogens. At the same time, we have strongly documented evidence such as that provided by Francis Choubousan in his book "Healthy Crops"*, that pathogenic microbes only invade plants with a fundamental nutritional imbalance. So again we can see that "environment determines genetic expression". Or perhaps William Albrecht states it best, "insects are nature's garbage collectors and disease is her cleanup crew".

From my perspective, all pest problems in agriculture are completely preventable and controllable by the powerful influence we have as farm managers, by maximizing any positive environmental factors we can and limiting the limiting factors to the best of our ability.

In the past, I have presented some of my target parameters for the optimum production of healthy crops and some of the results, which have been obtained in the field by using a systems-based approach to complete plant nutrition.

A concern I have is that we recognize in order to reach a reasonable measure of success, we must realize the need for a complete system which is much more than a band-aid approach utilizing drips and drenches. The primary key to plant nutrition, as I describe in the cover article, is the soil-plant digestive system. If this system is performing at sub-optimal levels, it is very difficult to attain our desired levels of plant mineralization and health.

So the production of healthy crops is predicated on having healthy soils which take time to become established.

The message I am attempting to convey is simply this: there is no such thing as plant food in a bag or jug. Feed the soil, let the soil feed the plant, and expect optimum results with several years' application of biologically sound scientific principles.

At this time, I would also like to announce the First Annual Advancing Eco-Agriculture Field Day scheduled for the 20th of July, Lord willing, to be held at our farm in Middlefield, Ohio. We anticipate quite an exciting day with discussion groups on several topics, ongoing field demonstrations of cover crop incorporation, and horse-drawn subsoiling (weather permitting), and a farm tour. Everybody is quite welcome and we hope to see you then.

A brief agenda is included in this newsletter.

Wishing you good farming, enjoyable learning, and good health. – JK

Modern Malnutrition

By Lawrence Mayhew

We live in a time of extreme malnutrition. No, not the stereotypical malnutrition that the mass media talks about (low calorie diets of children dying in third world countries), I'm talking about nutrients that are not federally mandated on the label of a box of breakfast cereal; selenium, iodine, molybdenum, cobalt, scandium, yttrium, rubidium, vanadium, tungsten, lanthanum, cerium and whole lot of other elements you probably never heard of.

This modern day version of malnutrition is particularly devastating to women and children.[1] It is estimated that 50% of all deaths and most cases of cancer can be attributed to trace element malnutrition.[2]

Although starting in the soil, trace element malnutrition is primarily the result of a poorly functioning digestive system, which is driven by the microflora in your gut. Ninety percent of all the cells in your body are microbes which are responsible for not only digesting food but also driving your immune system.

The similarities between your gut biology and the soil biology that supports plant health and nutrition are astonishingly similar. Both systems require a balance of complex nutrients.

Soil Malnutrition

In general, the typical American diet lacks many micronutrients, trace elements and ultra trace elements that were originally in our nutrient dense soils many years ago. Micronutrients, trace elements, and ultra-trace elements are now depleted either because they were removed along with crops that were harvested and shipped off the farm, or, like boron for example, naturally leach out of soils, especially if the soil is low in organic matter content.

Just like the micronutrients, some of the major soil elements that have a direct impact on our health, such as calcium and silicon, can either disappear or become tied up because of natural soil "weathering". In other words, if we left the soil alone and did nothing to it, it would still lose some of its natural elements.

The combination of natural soil weathering, removing micronutrients during harvest, and practices that degrade soil elements into forms that are not used by soil microbes, means that we must use management practices that "promote the cycling of resources, ecological balance, and conserve biodiversity".[3]

Mark your calendar!

Farmers' Conference Calls

We will be having conference calls for farmers who are interested. The dial-in number and call dates are listed below:

Dial-in number: 1-712-432-8787
Access Code: 91847

Call Dates:	July 8, 2010 August 12, 2010 September 9, 2010 November 11, 2010 January 13, 2011 March 10, 2011 April 14, 2011
Time of call:	2:00 PM Eastern Time

Complex Nutrients

Unless you have intentionally treated your soils with complex minerals from unique geological sources, your soils are lacking many of the essential trace elements. I tore the [Nutrition Facts] label off a box of cereal so you can see for yourself that the only micronutrients mentioned on this "food" label are zinc and copper, while the essential trace elements are completely overlooked. It takes more than two micronutrients to support high quality life.

The label represents America's obsession with fats, carbohydrates and vitamins while ignoring the essential trace elements that keep us healthy. Everything on that label is controlled by the federal government, including the order in which the nutrients appear and the thickness of the black lines.

But, the "Nutritional Facts" label does not reveal the true nature of the ingredients. There could be genetically modified ingredients and the sugar, vitamins and minerals are mostly, if not all, synthetic. Remember, your gut flora are responsible for converting your food into nutrients that provide you with energy and disease resistance. The 100 trillion microbes in your gut don't recognize synthetic materials as "food", so most of the junk that you eat goes to the liver for detoxification.

Liver disease is now immerging as one of the top 10 causes of death in the US[4], not the rest of the world, and the incidence of liver disease has increased dramatically since the introduction of high fructose corn syrup. Look at the label; the wheat bran flour keeps the cereal from meeting the legal definition of candy. Why is there so much sugar in our foods? It's because they have lost their flavor. Why have they lost their flavor? Because they lack real nutrients and nutrient density.

Plant Food vs. Real Nutrition

There are 110 known chemical elements. Almost all of them can be found in plants when they are present in soils where plants are grown. The reason why plants devote a lot of energy to taking up all of the trace elements and storing them in their tissue should be abundantly clear; they are necessary for humans or livestock that eat the plants. Of the 110 known elements, it can be easily argued that about 40 of the trace elements are absolutely essential to the healthy functioning of the global bio-ecosystem.

Just like the Nutritional Facts label shown here, fertilizer labels are highly regulated by the government. Everything from what elements are allowed to be listed, the order in which the elements are listed, to the type of fonts on the label, is regulated. Nitrogen, phosphorus and potassium get most of the attention, while the rest of the elements that are recognized as "essential" are relegated to secondary and micronutrient classifications. The total number of "plant food" ingredients that can be legally stated on a fertilizer label equals 15. Only 5 of those are trace elements.

Nutrition Facts

Serving Size 1/2 Cup (31g/1.1 oz.)
Servings Per Container About 17

Amount Per Serving	Cereal	Cereal with 1/2 Cup Vitamins A&D Fat Free Milk
Calories	80	120
Calories from Fat	10	10
	% Daily Value**	
Total Fat 1g*	2%	2%
Saturated Fat 0g	0%	0%
Trans Fat 0g		
Cholesterol 0mg	0%	0%
Sodium 80mg	3%	6%
Potassium 350mg	10%	16%
Total Carbohydrate 23g	8%	10%
Dietary Fiber 10g	40%	40%
Soluble Fiber 1g		
Sugars 6g		
Other Carbohydrate 7g		
Protein 4g		
Vitamin A	10%	15%
Vitamin C	10%	10%
Calcium	10%	25%
Iron	25%	25%
Vitamin D	10%	25%
Thiamin	25%	30%
Riboflavin	25%	35%
Niacin	25%	25%
Vitamin B_6	100%	100%
Folic Acid	100%	100%
Vitamin B_{12}	100%	110%
Phosphorus	35%	45%
Magnesium	25%	30%
Zinc	10%	15%
Copper	10%	10%

* Amount in cereal. One half cup of fat free milk contributes an additional 40 calories, 65mg sodium, 6g total carbohydrates (6g sugars), and 4g protein.
** Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

	Calories	2,000	2,500
Total Fat	Less than	65g	80g
Saturated Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Potassium		3,500mg	3,500mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Calories per gram: Fat 9 • Carbohydrate 4 • Protein 4

INGREDIENTS: WHEAT BRAN, SUGAR, HIGH FRUCTOSE CORN SYRUP, MALT FLAVORING, CALCIUM PHOSPHATE, CALCIUM CARBONATE, SALT, SODIUM ASCORBATE AND ASCORBIC ACID (VITAMIN C), REDUCED IRON, NIACINAMIDE, PYRIDOXINE HYDROCHLORIDE (VITAMIN B_6), RIBOFLAVIN (VITAMIN B_2), FOLIC ACID, THIAMIN HYDROCHLORIDE (VITAMIN B_1), VITAMIN A PALMITATE, VITAMIN B_{12} AND VITAMIN D.

CONTAINS WHEAT INGREDIENTS.

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The earth's ecosystem is primarily driven by soil and aquatic microorganisms[5]. The complex interactions of microorganisms with natural organic matter and minerals are responsible for governing soil health of the entire globe. Complex systems need complex inputs. That's why we make sure that all of the products we make are composed of complex materials.

Plants don't necessarily need 60 trace elements, but soil microbes, livestock and humans do. So, why not feed them to the plants? In concert with soil microbes, plants will end up containing elements that are in bio-organic forms (chelated) that are easily utilized by microbes, humans and livestock. When in chelated form, nutrients will actually be stored when in excess for use at a later time when needed, instead of leaching out of the soil or needlessly eliminated through the urine of livestock and humans.

The microflora of your intestine needs natural trace elements for their metabolism, and in return they provide you with more energy and a vigorous immune response. The same principle applies to plants as well. If trace elements are applied to soils or as foliar treatments in a form that is recognized by microbes, and if the plants are raised in a soil that is biologically active and all of the major soil nutrients are balanced, then the system has a greater potential to be healthy.

Just as the microflora in your body provides you with immune support, the soil microbes provide a tremendous amount of plant disease and pest resistance along with growth stimulating compounds. All of these processes are dependant upon the proper functioning of enzymatic systems, which are ultimately dependant on enzyme cofactors. Enzyme cofactors are dependant upon trace mineral compounds and ultra trace elements.

The Proof is in the Pudding

Your taste buds are designed to detect sugars because nature usually provides sugars along with a high nutrient content in natural foods. Your taste buds can be fooled by synthetic high fructose corn syrup, which is 20 times sweeter than common table sugar, but you can't be fooled if you know where your food comes from.

There are a lot of testimonials flying around about how livestock prefer eating forages that are biologically grown compared to conventionally grown. When brix levels are increased, forages are actually higher in sugars making them sweeter; you can taste it for yourself. Higher brix levels are an indicator that the plant is approaching its maximum level of genetic expression; trace and ultra-trace elements play a key role in that process.

[1] Lyons, G. Genc, Y, and Graham, R., 2009. Biofortification in the Food Chain, and Use of Selenium and Phyto-Compounds in Risk Reduction and Control of Prostate Cancer. . In: Development and Uses of Biofortified Agricultural Products, CRC Press, New York, pp. 17-44.

[2] Bonsman, S.S. and Hurrell, R.F., 2009. The Impact of Trace Elements from Plants on Human Nutrition: A Case for Biofortification. In: Development and Uses of Biofortified Agricultural Products, CRC Press, New York, pp. 1-15.

[3] National Organic Program § 205.2

[4] Center for Disease Control; Leading Causes of Death. Rate per 100,000 deaths. Source: http://www.cdc.gov/nchs/data/dvs/lead1900_98.pdf Accessed 2/10/2010.

[5] C. De Kimpe, 2002.Future Perspectives on the Environment and Human Health Interactions. In: A. Violante, P.M. Huang, J.M. Bollag, and L Gianfreda (eds.), Soil Mineral-Organic Matter-Microorganism Interactions and Ecosystem Health. Elsevier, pp. 415-427.

Practical Aspects of Plant Pest \ Interactions

Every farmer's goal should be to grow superior quality crops which are inherently resistant to pest problems, plants which possess a natural immunity to disease and insect attack, and can confer this immunity on animals and man, which utilize plants as primary food source. This is the foundation of "food as medicine".

So what are some of the fundamental differences in plants which have this immunity and plants which are susceptible to all manners of pest attack? Why can we have a healthy crop in one field and another with high susceptibility immediately adjacent?

In a previous article, I discussed the basic process which plants utilized to build plant compounds. The foundation of this process is photosynthesis which provides energy for the formation of all other groups of plant compounds. I also touched on the process of protein synthesis and how the production of complete compounds in a plant is of paramount importance in achieving total health and the roles of enzymes and trace minerals in this process.

I wish to expand and elaborate a bit on this process and provide some ideas for boosting plant health in the short term. From my perspective, there appears to be four major groups of compounds produced by a plant, all for very specific purposes.

These groups are:

1. Carbohydrates
2. Proteins
3. Lipids (fats & oils)
4. Plant Secondary Metabolites

It seems plants go through various phases of health as we transition towards complete immunity. The basic stage is in which plants begin to form complex carbohydrates from the simple sugars which are produced during photosynthesis. These more complex carbohydrates would be compounds such as lignin, cellulose, pectin, and others. This group of complete compounds helps form strong and sturdy plant stems and cell walls.

As plants begin to build reserves of pectin and other carbohydrates, they begin to shift over to Phase II which is defined as:

Protein Synthesis

After the formation of basic levels of complex carbohydrates and predicated on the availability of energy and nutrients, plants can begin to form complete proteins from their basic soluble constituents such as amino acids and amine compounds. Complete proteins are basic requirements for healthy reproduction and growth in the plants' cycle, but are not a food source for insect pests. Once plants have successfully transitioned through Phase II, they regularly acquire a low level of resistance to insect attack, especially to insects with simpler digestive tracts such as aphids, whiteflies, and caterpillars.

Often, while still in Phase II plants begin the transition to Phase III which is defined as producing elevated levels of:

Lipids

Plants produce lipids at earlier stages as they are an essential constituent of the cell membrane. However, as they become healthier they begin producing significantly elevated levels of these lipids, which provides for a plant very high in energy as well as providing a significant increase in water conservation and moisture stress tolerance. From this level of achievement we have already begun the transition to Phase IV:

Plant Secondary Metabolites

Here is where the medicine comes from. Plant secondary metabolite is a term used to cover a very broad group of highly complex compounds which includes groups of phenolic compounds, terpenoids, bioflavonoids, and other phyto alexins. These compounds are known as "plant protectors" and provide protection against ultra violet radiation, insect pests, fungal and bacterial diseases. These "nutriceutical" and aromatic compounds can have powerful antifungal and antibacterial properties as well as inhibiting insects from

feeding on plants. This category of plant secondary metabolites also includes compounds such as plant hormones which provide a major influence in growth and reproduction.

So how can we utilize the benefits of these plant secondary metabolites in our crop production systems?

Obviously, we need to provide for the plants' nutritional requirements to the best of our ability, as explained in the cover article, in an effort to reach a level of soil fertility and plant health at which our plants can synthesize these compounds on their own. However, as we know, this transition can take time. What can be done in the meantime with the issues we face in the field today?

In an effort to provide sustainable and ecological answers to these concerns, we have developed a material called E-Scent-Shield™. This material is a super concentrated package of these plant secondary metabolites blended with very unique surfactants and emulsifiers, which enable it to adhere well to the leaf surface as it becomes absorbed and is translocated throughout the entire plant.

Based on the limited research we have accomplished to date, E-Scent-Shield™ appears to have many possible uses as a microbial inhibitor and also as an insect prevention and control tool.

It could be utilized very well in a prevention program with other health enhancing materials such as micronized minerals and trace minerals foliar applied onto a growing crop. We expect excellent results from this material as more field trails are being conducted.

- JK

Field Day Agenda

8:00 AM Registration

9:00 AM Welcome

9:30 AM Presentations

Foundations of Soil Fertility

Principles of Spoon Feeding Nutrients

Principles of Crop Monitoring

11:00 PM Lunch

12:30 PM Discussion Groups

Tomatoes

Vine Crops

Fruits and Berries

2:00 PM Farm Tour

Equipment Demonstrations/
Cover Crop Incorporation all day

Call **440-632-1012** to confirm your attendance

And Don't forget....

Join us on the ***Farmer Conference Call***
See page 4 for details

ADVANCING ECO-AGRICULTURE
15266 Hayes Rd., Middlefield, OH 44062

Connecting the Missing Links for
Full Potential Agriculture

You are invited to join us on:

Tuesday, July 20, 2010
15266 Hayes Rd., Middlefield, OH 44062

Advancing Eco-Agriculture's

1st Annual Field Day!

Presentations • Discussion Groups • Tours...See Agenda on page 7 inside.