AGRONOMIC

WHAT HAPPENS WITHIN THE CORN PLANT WHEN DROUGHT OCCURS? [2]

Info below is from University Of Wisconsin August 21, 2003 issue of **Wisconsin Crop Manager** (Joe Lauer, Author)

Evapotranspiration is both the water lost from the soil surface through evaporation and the water used by a plant during transpiration. **Soil evaporation** is the major loss of water from the soil during early stages of growth. As corn leaf area increases, **transpiration** gradually becomes the major pathway through which water moves from the soil through the plant to the atmosphere.

Yield is reduced when evapotranspiration demand exceeds water supply from the soil at any time during the corn life cycle. Nutrient availability, uptake and transport are impaired without sufficient water. Plants weakened by stress are also more susceptible to disease and insect damage. **Corn responds to water stress by leaf rolling.** Highly stressed plants will begin leaf rolling early in the day. Evapotranspiration demand of corn varies during its life cycle. Evapotranspiration peaks around canopy closure. Estimates of peak evapotranspiration in corn range between 0.20 inches and 0.39 inches per day. Corn yield is most sensitive to water stress during flowering and pollination, followed by grain filling and finally vegetative growth stages.

ESTIMATED CORN EVAPOTRANSPIRATION AND YIELD LOSS PER STRESS DAY DURING VARIOUS STAGES OF GROWTH

GROWTH STAGE	EVAPOTRANSPIRATION (Inches Per Day Of Water)	PERCENT YIELD LOSS PER DAY OF STRESS (Minimum – Average – Maximum)
Seedling To 4 Leaf	0.06	
4 Leaf To 8 Leaf	0.10	
8 Leaf To 12 Leaf	0.18	
12 Leaf To 16 Leaf	0.21	**Min**: 2.1% – **Avg**: 3.0% – **Max**: 3.7%
16 Leaf To Tasseling	0.33	**Min**: 2.5% – **Avg**: 3.2% – **Max**: 4.0%
Pollination (R1)	0.33	**Min**: 3.0% – **Avg**: 6.8% – **Max**: 8.0%
Blister (R2)	0.33	**Min**: 3.0% – **Avg**: 4.2% – **Max**: 6.0%
Milk (R3)	0.26	**Min**: 3.0% – **Avg**: 4.2% – **Max**: 5.8%
Dough (R4)	0.26	**Min**: 3.0% – **Avg**: 4.0% – **Max**: 5.0%
Dent (R5)	0.26	**Min**: 2.5% – **Avg**: 3.0% – **Max**: 4.0%
Maturity (R6)	0.23	

VEGETATIVE DEVELOPMENT: **Water stress during vegetative development reduces stem and leaf cell expansion resulting in reduced plant height and less leaf area.** Leaf number is generally not affected by water stress. Corn roots can grow between 5 and 8 feet deep, and soil can hold 1.5 to 2.5 inches of available soil water per foot of soil, depending upon soil texture. Ear size may be smaller. Kernel number (rows) is reduced. Early drought stress does not usually affect yield in Wisconsin through the V10 – V12 STAGES. Beyond these stages water stress begins to have an increasing effect on corn yield.

POLLINATION: Water stress around flowering and pollination delays silking, reduces silk elongation and inhibits embryo development after pollination. Moisture stress during this time reduces corn grain yield 3 – 8% for each day of stress. **Moisture or heat stress interferes with synchronization between pollen shed and silk emergence. Drought stress may delay silk emergence until pollen shed is nearly or completely finished.** During periods of high temperatures, low relative humidity and inadequate soil moisture level, exposed silks may desiccate and become non-receptive to pollen germination.

KERNEL DEVELOPMENT (grain-filling): Water stress during grain-filling increases leaf dying, shortens the grain-filling period, increases lodging and lowers kernel weight. Water stress during grain-filling reduces yield 2.5 – 5.8% with each day of stress. **Kernels are most susceptible to abortion during the first two weeks following pollination, particularly kernels near the tip of the ear.** Tip kernels are generally last to be fertilized, less vigorous than the rest and are most susceptible to abortion. Once kernels have reached the dough stage of development, further yield losses will occur mainly from reductions in kernel dry weight accumulation.

PREMATURE PLANT DEATH: Premature death of leaves results in yield losses because the photosynthetic "factory" output is greatly reduced. The plant may remobilize stored carbohydrates from the leaves or stalk tissue to the developing ears, but yield potential will still be lost. Death of all plant tissue prevents any further remobilization of stored carbohydrates to the developing ear. **Whole plant death that occurs before normal black layer formation will cause premature black layer development, resulting in incomplete grain fill and lightweight, chaffy grain.** Grain moisture will be greater than 35%, requiring substantial field drydown before harvesting.

AGRONOMIC

SOME OF THOSE CORN PLANTS ARE THIRSTY! [2]

(Or... What Causes Leaf Rolling?)

Info below is from Purdue University July 12, 1996 issue of **Purdue Pest Management & Crop Production Newsletter** [R. L. (Bob) Nielsen, Author]

REASON FOR LEAF ROLLING: This is indeed a response of the corn plant to insufficient plant moisture content. As plant moisture content declines, the corn plant often "protects" itself from excessive plant moisture loss (transpiration) by rolling its leaves. **The rolled leaf offers less exposed surface area and transpiration is reduced.** Thus, the act of leaf rolling is a sort of defensive posture by the corn plant against inadequate plant moisture. In fact, one should probably prefer a hybrid whose leaves roll readily over one that remains unrolled during times of severe plant moisture deficits.

CAUSES OF PLANT MOISTURE DEFICITS: Take the time to determine the true cause of leaf rolling. **Plant moisture deficits do not necessarily reflect simply an unavailability of soil moisture.** Other factors may not allow the corn plant to take up the soil moisture it requires. Consider some of the following problems that can cause plant moisture deficits. Coupled with low humidity and high temperatures, these factors can quickly cause insufficient plant moisture levels. **These include** – soil compaction, shallow corn rooting, root damage and restricted root development.

YIELD LOSS TO LEAF ROLLING: Leaf rolling itself does not always translate to grain yield loss in corn. The extent of any yield loss depends on the nature of the problem(s) that is reflected by the leaf rolling symptom. **"Ordinary" leaf rolling during the heat of the day, when transpiration cannot keep up with high temperatures and low humidity, is a defensive posture by the corn plant and won't affect yield.** If true drought stress develops and leaf rolling persists for 12 hours or more a day, then grain yield would likely decrease, particularly during the two weeks before to two weeks after pollination.

If the leaf rolling is an indicator of other severe root problems as described above, then yield loss is more likely to occur. Take the time to diagnose the cause(s) of the leaf rolling. If tillage or planting mistakes have been made, learn from them. If the problem can be corrected, do so. If the problem can be prevented next year, do so.

AGRONOMIC

WARM NIGHTS ARE NOT IDEAL FOR CORN. [2]

Info below is from **Modern Corn And Soybean Production**, 2000 First Edition, page 18
(R. G. Hoeft, E. D. Nafziger, R. R. Johnson & S. R. Aldrich, Authors)

During warm nights (temps in the 80°'s F), the cell respiration rate increases rapidly and can result in more yield potential being lost through respiration than is stored in the grain. **Cooler nights (60°'s and lower 70°'s F)**, on the other hand, will allow more of the energy that is produced during the day to be stored as yield.

Info below is an agronomic fact often referenced by agronomists.

Growth involves accumulation of dry weight from photosynthesis during the day; and loss from respiration at night. **When nights are too warm, respiration loss is excessive.** The result is similar on a very cloudy, warm day.

AGRONOMIC

CAN WARM NIGHTS REDUCE GRAIN YIELD IN CORN? [6]

Info below is from Ohio State University July 19, 2010 – July 27, 2010 issue of **C.O.R.N. Newsletter 2010-22**
(Peter Thomison, Author)

High night temps (in the 70s or 80s) can result in wasteful respiration and a lower net amount of dry matter accumulation in plants. The rate of respiration of plants increases rapidly as the temp increases, **approximately doubling for each 13°F increase**. With high night temps, more of the sugars produced by photosynthesis during the day are lost; less is available to fill developing kernels, thereby lowering potential grain yield. High night time temps result in faster heat unit (GDD) accumulation **that can lead to earlier corn maturation**, **whereas cool night temps result in slower GDD accumulation that can lengthen grain filling and promote greater dry matter accumulation and grain yields**.

Past research at the University Of Illinois indicates that corn grown at night temps in the mid-60s outyields corn grown at temps in the mid-80s. Corn yields are often higher with irrigation in western states, which have low humidity and limited rainfall. While these areas are characterized by hot sunny days, night temps are often cooler than in the Eastern Corn Belt. Low night temps during grain fill have been associated with some of Ohio's highest corn yields in past years. Last year, when the highest corn average yield to date was achieved, Ohio experienced one of its coolest Julys on record. The cool night temps may have reduced respiration losses during early grain fill and lengthened the rain fill period.

AGRONOMIC

NONE LIKE IT HOT [3]

(Talking Corn Here, But The Same Works For Beans.)

Info below is from University Of Missouri August 11, 2006 issue of **Integrated Pest And Crop Management** (Bill Wiebold, Author)

The recent period of hot temps may have affected corn and soybean yields more than assumed from observing stress symptoms of the affected plants. Stress symptoms are almost always related to low water availability, but high temps can damage plants or reduce yields even if there is adequate moisture availability.

It is important to remember that plants react to temps differently than humans… who must evaporate water to dissipate heat. High humidity reduces evaporation and greatly affects the way a particular temp feels. Thus, weather stations report heat indices that are an attempt to estimate how air temp "feels" to humans. High humidity translates into heat indices that are often five or more degrees above air temp. Heat indices have little relationship to the effects of temp on plants.

Sometimes leaf temp is more important to plants than air temp. Leaves function as a solar collector… that is, they are designed to absorb light energy. They do this in order to build sugars and produce other products necessary for life (and yield). **However, very little of the light energy is actually used to do this work (photosynthesis). Light energy not used for photosynthesis causes leaf temp to rise.**

Plants dissipate heat through water **evaporation** from cell surfaces, **convection** and **conduction**. Changing liquid water to water vapor requires substantial energy and this energy loss causes the cooling effect. **Conduction** means the warm leaf surface warms… giving energy to the air touching the leaf. **Convection** means cooler air is moved closer to the leaf surface and displaces warmer air. These three methods of heat dissipation are very much interrelated… and without them the leaf temp would quickly rise to the point where plants could not survive.

It is not uncommon for leaf temp to be higher than air temp… especially on bright sunny days with little wind. **With good moisture supply,** evaporation will be fast enough to keep leaf temps fairly close to air temp. **With limited moisture supply,** stomates will close reducing water evaporation and increasing leaf temp.

Nearly all of the chemical reactions necessary for the life of plants are controlled by enzymes. The rates of these chemical reactions increase with temp, so for example – plant growth and weight gain are greater at 80°F than at 55°F. These enzymes have a three-dimensional shape and can warp (change shape) at high temps. An extreme example of temp affecting protein is the frying of an egg. The heat causes the egg protein to change its shape and become solid. The effect of temp on plant enzymes isn't nearly that dramatic, but temps of 100°F to 105°F can affect the shape of plant enzymes. When the shapes of the enzymes change, they no longer work as well. In other words, the reaction rate decreases. **That is why 86°F is often given as the optimum temp for corn and soybean growth.** Although the optimum is fairly flat for about 15 degrees, temps above the optimum slow many of the important reactions including those involved in photosynthesis.

So, high temps can harm crop plants and reduce yield. This direct affect from high temp is probably small in most years… but when temps top 100°F as they did several times in July 2006, yield was reduced… at least slightly. Unfortunately, high temps have other effects on plants. One almost hidden effect from increased temp is the differential effects it has on photosynthesis and respiration. **Photosynthesis is "income"** for the plant world and **respiration is an "expense."** The difference between the two, net photosynthesis is the "net income." Within reason, high amounts of net photosynthesis often translate into high yield.

Some respiration is essential, just as some expenses are essential. Respiration oxidizes ("burns") sugars to produce energy that is needed for many of the life processes. However, some respiration is wasteful because it burns away or oxidizes sugars that could have been stored in seeds as yield. **Hot temps stimulate respiration more than photosynthesis and reduce the plant's net income.** This is particularly true during the night when there is no photosynthesis. Warm night temps can decrease yield without showing any visible effects on the plants. Although high humidity can be beneficial to plants because water evaporation is reduced and this reduces water stress, high humidity also slows the rate by which temps cool at night. It is not uncommon for temp to remain above 80°F during summer nights if humidity is high (dew point above 65°F). So, although plants do not "feel" a high heat index, they are affected by the slow temp decline during nights of high humidity through increased respiration.

It is difficult to separate the effects of high temp from the effects of water stress. Often these two stresses occur together and magnify the effects from each other. But, high temps can reduce yield even if plants exhibit no symptoms of water stress.

VEGETATIVE

FLOODING AND PONDING: HOW LONG CAN CORN TOLERATE "WET FEET?" [2]

Info below is from Purdue University June 1999 (Revised June 2000) issue of **Corny News Network Articles** [R. L. (Bob) Nielsen, Author]

The growth stage of a corn crop greatly influences whether ponding or saturated soil kills, severely stunts or mildly stunts the corn plants. Plants younger than V6 STAGE are susceptible to damage for two reasons. **First of all, the growing point in such young corn is at or below the soil surface and therefore is also subject to the stress of oxygen-depleted conditions.** Once the growing point is above the water level the likelihood for survival improves greatly.

Secondly, plants younger than V6 are in the process of trying to successfully establish a vigorous root system. Stunting or death of roots by oxygen-depletion can be a major stress for a plant that is not yet fully established.

Prior to leaf stage V6 (six-leaf stage as measured by visible leaf collars), corn can survive only two to four days of flooded conditions. **If temperatures are warm during flooding (greater than 77°F), such young plants may not survive 24 hours.** Cooler temperatures prolong survival.

If flooding in corn is less than 48 hours, crop injury should be limited. To confirm plant survival, check the color of the growing point (it should be white and cream colored, while darkening or softening usually precedes plant death) and look for new leaf growth three to five days after water drains from the field.

Plants older than V6 will tolerate ponding or saturated soils longer for essentially the opposite reasons. As plants develop beyond V6, rapid stalk elongation elevates the growing point region above the soil surface and, thus, away from the direct stress of flooded soils. Secondly, an older crop's root system will simply be larger and consequently the crop can tolerate a certain amount of root death without dying or dramatic stunting.

Nonetheless, extended periods of saturated soils plus warm temperatures will take their toll on the overall vigor of the crop. **Some root death will occur and new root growth will be stunted until the soil dries to acceptable moisture levels.** As a result, plants may be subject to greater injury during a subsequently dry summer because root systems are not sufficiently developed to access available subsoil water.

Concomitant (I found a new word in the dictionary... it means something that accompanies something else) with the direct stress of saturated soils on a corn crop, flooding and ponding can also cause losses of soil nitrogen through denitrification and leaching of nitrate N. Significant loss of soil N will result in nitrogen deficiencies in the corn crop that may cause additional yield loss.

Certain disease problems which may become greater risks due to flooding and cool temperatures are corn smut and crazy top. **The fungus that causes crazy top depends on saturated soil conditions to infect corn seedlings.** There is limited hybrid resistance to these diseases and predicting damage is difficult until later in the growing season.

REPRODUCTIVE

EAR INITIATION AND SIZE DETERMINATION IN CORN [2]

Info below is from Purdue University June 10, 2003 issue of **Corny News Network Articles** [R. L. (Bob) Nielsen, Author]

The number of harvestable kernels per ear is an important contributor to the grain yield potential of a corn plant. **Severe plant stress during ear formation may limit the potential ear size and thus grain yield potential, before pollination has even occurred.** Optimum growing conditions set the stage for maximum ear size potential and exceptional grain yields at harvest time. **The size of what will become the harvestable ear begins by the time a corn plant has reached knee-high and finishes 7 to 10 days prior to silk emergence.**

EAR SHOOT DEVELOPMENT: By about the V5 or V6 stages of development (five to six visible leaf collars), the growing point (apical meristem) of the corn plant finishes the task of initiating leaf primordia and completes its developmental responsibilities by initiating the tassel primordium of the plant. **At about the same time that the tassel is initiated, the uppermost harvestable (and final) ear is also initiated (Lejeune and Bernier, 1996).** This uppermost ear is normally located at the 12th to 14th stalk node, corresponding to the 12th to 14th leaf.

Initially, the ear shoots found at the lower stalk nodes are longer than the ones at the upper stalk nodes simply because the lower ones were created earlier. As time marches on, the upper one or two ear shoots assume priority over all the lower ones and ultimately become the harvestable ears. Development of the upper ears is favored over the lower ones because of hormonal “checks and balances”, plus the proximity of the upper ear to the actively photosynthesizing leaves of the upper canopy.

EAR SIZE DETERMINATION: Row number and kernel number per row are two yield components in corn. Every pair of rows is generally equal to about 20 bushels per acre (for average populations and ear lengths). For a 16-row ear, one kernel per row is equal to about five bushels per acre (for average populations). **Typically, from 750 to 1,000 ovules (potential kernels) develop on each ear shoot.** The number of kernel rows multiplied by the number of kernels per row determines total kernel number per ear. Actual (harvestable) kernel number per ear averages between 400 and 600.

KERNEL ROW NUMBER DETERMINATION: This begins on the uppermost ear shortly after the ear shoot is initiated (V5 to V6) and is thought to be complete by growth stage V12. **Like so many other processes in the corn plant, kernel row number determination on an ear proceeds in an acropetal fashion (from base to tip).**

Kernel rows first initiate as “ridges” of cells that eventually differentiate into pairs of rows. Thus, row number on ears of corn is always even unless some sort of stress disrupts the developmental process. True row number is often difficult to visualize in tiny ears dissected from plants younger than about the 12-leaf stage.

Row number is determined strongly by plant genetics rather than by environment. **This means that row number for any given hybrid will be quite similar from year to year, regardless of growing conditions.** Some exceptions to this include potential injury from the POSTemergence application of certain sulfonylurea herbicides or nearly complete defoliation by hail damage prior to growth stage V12.

The potential number of kernels per row is complete by about one week before silk emergence from the husk. Kernel number (ear length) is strongly affected by environmental stresses. This means ear length will vary dramatically from year to year as growing conditions vary. Severe stress can greatly reduce potential kernel number per row. Conversely, excellent growing conditions can encourage unusually high potential kernel number.

REPRODUCTIVE

CORN FLOWERING (POLLEN SHED AND SILKING) [5]
(The Order Of Events)

Info below is from **Modern Corn And Soybean Production**, 2000 First Edition, page 10
(R. G. Hoeft, E. D. Nafziger, R. R. Johnson & S. R. Aldrich, Authors)

TASSEL EMERGENCE: The tassel normally is visible a week or more before the first silks, but **pollen shedding is delayed 2 or 3 days before the first silks.** Pollen shedding usually continues 5 to 8 days.

EAR EMERGENCE: Ordinarily, the tip of the tassel can be seen at about the same time that the tip of the emerging ear becomes visible. **The tassel emerges from the enclosing leaves before pollen shed begins,** which is usually 1 or 2 days before silks first appear.

POLLEN GRAINS: The number of pollen grains produced by a vigorous corn tassel is usually between 2 million and 5 million. If there are 1,000 silks per ear, then there are 2,000 to 5,000 pollen grains produced for each silk. **The pollen anthers open at the tip,** usually in early to mid-morning as the humidity decreases, and pollen grains pour out.

REPRODUCTIVE

"MISSING THE NICK" IN CORN POLLINATION [2]

Info below is from **Modern Corn And Soybean Production**, 2000 First Edition, pages 11 – 12
(R. G. Hoeft, E. D. Nafziger, R. R. Johnson & S. R. Aldrich, Authors)

Ordinarily, **the first silks produced on a plant emerge from the enclosing husks 1 - 3 days after pollen shed has begun.** Under favorable growing conditions, all silks will emerge and be ready for pollination within 3 – 5 days, thus there is time for all silks to receive pollen before the tassel stops shedding pollen. **NOTE: pollen shed continues for several days – 5 to 8 is usual – with peak production about the third day** (FAKnell comment). As is the case with other plant parts, silk growth takes place mostly at night; studies have shown that silks can grow 2 – 3 inches in a single night. The silks from near the base of the ear emerge first, after growing for several days, and those from the tip appear last.

Hot, dry weather conditions are more likely to interfere with pollination than is wet weather. **The most common problem caused by dry weather is the slow growth of silks, which can result in failure of silks to emerge in time to receive pollen.** Silks will continue to grow, sometimes reaching lengths of 6 inches or more, if they do not receive pollen.

REPRODUCTIVE

CHECKING EAR POLLINATION [2]

Info below is an agronomic fact often referenced by agronomists.

Check pollination success about one week after pollination by carefully removing the husks and gently shake the ear. Silks will fall off the fertilized ovules. **Silks remaining attached are on ovules that did not get fertilized.**

REPRODUCTIVE

SCRAMBLED SILKS, ANYONE? [2]

(Or… What Causes "Silk Balling?")

Info below is from Purdue University July, 2000 issue of **Corny News Network** [R. L. (Bob) Nielsen, Author]

The potential problem of which I speak is a phenomenon traditionally called "silk balling." I prefer the name "scrambled silks" because I think it is more descriptive. The problem is one in which silk elongation, prior to their emergence from the husk leaves, is interrupted or altered, resulting in a mass of scrambled silks near the tip of the cob that never fully emerge from the husk. **Obviously, any silks that fail to emerge from the husk will not be exposed to any pollen and consequently will not contribute to the formation of kernels on the cob.** The net result is some degree of barrenness on the cob and, as a result, lower yield.

Scrambled silks is a relatively infrequent problem and its causes are not well understood. Some believe the occurrence of cool nights (low 60's or cooler) prior to silk emergence plays a role in the development of scrambled silks. Others believe rapid changes in temperature patterns (e.g., very warm to very cool) prior to silk emergence encourages the problem. Hybrids with naturally tighter husks seem to be more susceptible to developing scrambled silks.

Unfortunately, there is nothing you can do about preventing or avoiding the problem. **Typically, the severity of the resulting poor kernel set is low and concentrated near the tip end of the cob.** However, I've seen situations in the past where scrambled silks resulted in severe barrenness in nearly 1/3 of the plants in the field.

Affected plants will likely raise red flags later on in the grain filling process. By this, I mean that any plants severely afflicted with barrenness will eventually develop purpling or reddening of leaf midribs, leaf sheaths and other plant parts. **The reasons for this discoloration are similar to those for purple corn earlier in the growing season.** An otherwise healthy plant whose ear is highly barren of kernels is a plant that is overproducing photosynthate (source) relative to the demands of existing kernels (sink). The excess sugars in the leaves and stalk trigger the formation of anthocyanin pigments in the plant tissues, especially in those hybrids with quite a few of the purpling genes. The similarity to early season purple corn is in connection between excess plant sugars and anthocyanin production. Early in the season, excess plant sugars often result when root development is hindered for some reason.

REPRODUCTIVE

DO CORN TILLERS HELP OR HURT GRAIN YIELDS? [2]

Info below is from Alabama Cooperative Extension System April 07, 2004 issue of **An Ear Full, The Alabama Corn Newsletter**

It was common belief in the early 1900's that tillers would suck nutrients from the main plant. The term "sucker" came from this notion. Plant Physiologists at the University Of Wisconsin found little movement of food (plant sugars) takes place between the main plant and tillers before tasseling. **However, immediately after silking and during grain fill, substantial amounts of food (plant sugars) moved from leaves of large tillers without ears to the ear on the main plant.** There was little food movement when ears were on both the tiller and main plant. The only time when food (plant sugars) moved from the main plant to the tiller was when there was an ear on the tiller and there was no ear on the main plant. This is not a condition likely to occur in the field. **In most situations where you have small shaded tillers without ears under a full stand, tillers will have little influence on grain yield.** If there is a slight influence on grain yield, it would most likely be in the positive direction.

REPRODUCTIVE

TASSEL-EARS IN CORN [2]

Info below is from Purdue University July 13, 2004 issue of **Corny News Network Articles** [R. L. (Bob) Nielsen, Author]

A corn plant exhibits both male flowers and female flowers (a flowering habit called "monoecious"). Interestingly, both flowers are initially bisexual (aka "perfect"), but during the course of development the female components (gynoecia) of the male flowers and the male components (stamens) of the female flowers abort, resulting in tassel (male) and ear (female) development. **Once in a while, the upper flower that typically becomes a tassel instead forms a combination of male and female floral parts on the same reproductive structure.** This "tassel-ear" is an odd-looking affair and is found most commonly on tillers or "suckers" of a corn plant along the edges of a field. Without a protective husk covering, the kernels that develop on tassel-ears are at the mercy of weathering and exposed to hungry birds. Consequently, harvestable good quality grain from tassel-ears is a rarity. **Tassel-ears are rarely a yield-influencing factor (negative or positive).**