

Indiana Thunderstorms

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Thunderstorms occur during about 50 days annually in each part of central Indiana, in about 45 days in northeastern Indiana and in about 55 days in the State's southwestern corner. During the summer, each locality normally has thunderstorms in about two days per week. In about ten days per year, mostly in summer, two thunderstorms occur, one in the afternoon and one at night. Lightning from distant storms, too far away to have appreciable local significance, may be visible on one or two additional nights per week in summer. Most thunderstorms cover only about one-fourth of the state and many of them cover less than a sixth of it. Hence it is probable that fully 200 individual thunderstorms occur per average year in Indiana.

Thunderstorms are such a significant environmental influence in Indiana that it is highly desirable that more of the State's leaders be well informed about them. Increased knowledge facilitates, of course, greater appreciation and wiser adjustments.

Thunderstorms are significant in several respects. They form a major source of rainfall, cause a sharp drop in temperature, commonly have at least a little strong wind; their most distinctive feature is thunder, induced by lightning. Their cloud effects are noteworthy, some of the most imposingly beautiful seen anywhere. They often yield hail as well as rain. Altogether they are perhaps the most impressive atmospheric phenomenon commonly seen, highly useful in the aggregate, but locally often seriously harmful. The good they do, aside from the rain they bring, which often is highly welcome, includes the invigorating drop in temperature, the awe-inspiring display of cloud, lightning and wind, and the generally stimulating effect of the dramatic change of weather. The harm they do includes the squall wind, generally just before the rain commences. This gust often is violent enough to do considerable damage. The annual average property loss from thunderstorm squall winds in Indiana is officially estimated at about \$400,000. Rain often falls torrentially, with the result that a large share of that which falls upon sloping ground runs away. Much of the soil erosion of our fields is due to thunderstorm rain. "Cloudbursts" not only cause erosion but they sometimes produce locally harmful floods. The lightning incidental to thunderstorms affords a spectacular display of usually harmless fireworks but also often does damage. Each average year seven people are killed by lightning in Indiana. Many thousand livestock are also killed, apparently an average of more than 4000 hogs and 1000 cattle and numerous horses. Fires started by lightning

annually destroy buildings worth about a half million dollars in Indiana, and some crops. The lightning of thunderstorms does good as well as harm. Every flash combines some atmospheric nitrogen and oxygen to form ammonia, which when carried into the soil by rain adds fertility. This is an important source of increased fertility. At the few stations in northeastern United States where prolonged studies of this subject have been made, six to eight pounds per acre per year are added thus. Lightning flashes also create ozone, an unstable form of three oxygen atoms (O_3). Ozone has a pungent odor; some evidence indicates that it has a stimulating influence upon mental activity.

Lightning is most dangerous at the beginning of the storm, just after the squall wind, when many lightning flashes travel downward. Later, lightning commonly is between parts of the storm or even upward from the ground.

Hail which falls in many thunderstorms is a convincing proof that the air is cold overhead even in hot weather. It also proves that the updrafts of air which make the imposing thunderhead are strong. Hail does considerable damage in Indiana, where there are an average of about 5 "heavy" hailstorms each season and a like number of "moderately heavy" hailstorms. Indiana's hailstorms cause an estimated average damage to crops and glass somewhat in excess of \$1,000,000 per year.

The average thunderstorm in Indiana yields somewhat more than a half inch of rain, but many yield an inch and some yield more than three inches. Indeed, rarely, a "cloudburst" may yield more than 5 inches. Rainfalls of more than 2 inches in an hour are almost sure to cause considerable local flooding in Indiana, and serious soil erosion on cultivated slopes.

The value of the rainfall yielded by thunderstorms depends, of course, on when it comes. If, as frequently happens, it comes when it is badly needed, a single thunderstorm may locally increase the yield of corn to the extent of several thousand dollars per square mile. For example, in late August, 1947, when this paper was being completed, the drouth in Indiana was reducing each day the prospective corn crop an estimated million bushels. A "good" thunderstorm in the critical period of corn growth, following a prolonged dry, hot spell, increases the average per acre yield in its area at least several bushels per acre, and therefore is worth more than \$1,000,000.

About half of Indiana's summer thunderstorms occur in the afternoon (noon to 6 P.M. local time). Afternoon thunderstorms are somewhat more characteristic of southeastern Indiana than of northwestern.

About one-fourth of Indiana's summer thunderstorms occur between 6 P.M. and midnight, local time. Evening thunderstorms are somewhat more characteristic of northwestern Indiana than of southeastern.

The half-day, midnight to noon, has somewhat less than one quarter of the thunderstorms in Indiana. Very few occur in the forenoon, more occur shortly before dawn.

June is the month of most thunderstorms in the western half of Indiana while July has most in the eastern half. Thus in central Indiana the last week in June or the first week in July are those of most thunderstorms.

Hail always occurs in thunderstorms in Indiana, but only about one-tenth of the thunderstorms yield damaging amounts of hail. Hail storms are most frequent, however, somewhat earlier than the month of most thunderstorms. May has had most hailstorms in most of Indiana but along the eastern margin of the State, hail is somewhat more frequent in April than in May.

Tornadoes are also always associated with thunderstorms. Like hailstorms, they are most numerous, however, before the month of most thunderstorms. In Indiana, May has most tornadoes except at the extreme south, where March or April has more tornadoes than May.

(Additional data on Indiana's lightning, hail, tornadoes and squalls may be found in "Climate of Indiana" but this article notably supplements the discussion in that volume of thunderstorms.)

Summary and Conclusions

Indiana has thunderstorms on about 50 days per average year, of which about ten days have two. As most of the thunderstorms cover only about a fourth of the State, about 200 individual thunderstorms per average year occur in Indiana. About half of them occur in the afternoon and a quarter between 6 p.m. and midnight. About half of the year's total occur in summer, when each locality normally has two or three per normal week. Thunderstorms are the major source of summer rain and are significant in several additional respects. They cause an often welcome cooling, and impressively beautiful displays of cloud and lightning. They also often cause considerable damage by their lightning, hail, squalls and "cloudbursts". In an average year the lightning kills 7 people in Indiana, burns buildings and crops and kills farm animals worth an aggregate of about \$500,000; the hail causes an estimated annual million dollars of damage to crops and glass; the squall winds damage buildings to the extent of an annual average of \$400,000. The erosion of cultivated slopes and the occasional local flooding also cause sizeable losses. But the good that the rain does generally much more than offsets the damage caused in these other ways. If proper care is taken as to lightning rods and hillside land use, the losses can be much reduced. Following hot dry spells, a single thunderstorm may increase crop yields by more than a million dollars. Without thunderstorms, Indiana would necessarily be a third rate agricultural state despite its several other advantages, and would also be much less desirable for industry in various other respects. Therefore it behooves us to appreciate them and make appropriate adjustments.