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THE ADJECTIVE CLASSIFICATION FOR DEW: WHAT DOES IT MEAN? (1)

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1. INTRODUCTION

Most agricultural dew forecasts and field observations are given as a simple adjective classification -- light, moderate, heavy, and (sometimes) very heavy. Unfortunately there are few guidelines indicating what this classification means in quantitative terms. Observations are visual; no instrumentation is used. Also, Getz (2), in his discussion of the instrumented dew monitoring network in the southeast, states that the sensors used in their Davis-Hughes instrumentation (3) was visually calibrated under conditions of very heavy dew or fog; very heavy dew is determined by looking at wetness of nearby vegetation. Therefore, this system is also qualitative.

Dew is an important factor in such diverse activities and problem areas as wildland fire danger rating, plant disease, insect activity, pesticide application, and crop harvesting. It would be operationally helpful in each of these areas to arrive at a common understanding of dew adjective ratings. The objectives of this paper are to recommend guidelines for defining adjective ratings quantitatively and also to consider some of the problems inherent in the current observational systems.

2. PHYSICAL PROCESSES THAT INFLUENCE ESTIMATES AND FORECASTS

Dew deposition, which may range from light to heavy across a field, both vertically and horizontally, is controlled by a number of processes. Of special importance to this discussion are: differing radiating characteristics of deposition surfaces, and the distillation-dewfall effect.

As examples of the first, Shaw (4) found that from 0200 to 0600 on rainless nights, dew was present on soybeans 63 percent of the time but only 41 percent on corn. Angus (5) found that a 25cm high artificial shrub collected about 40 percent more dew than an equally high field of grass. There is no standard surface used universally in dew measurement, although the Duvdevani (6) dew blocks were once seriously considered as an official standard. Consequently, the issue of non-uniform measurement surfaces is unresolved.

Regarding the second process, the source of moisture condensed as dew determines the distillation-dewfall ratio, according to Monteith (7, 8). Distillation results from the upflux of moisture from the soil while dewfall results from the downflux of moisture from the atmosphere. Monteith calculated that for very low wind speeds the dewfall-distillation ratio over short grass should be about 0.2. But in a wheat crop 90cm high, Burrage (9) found that dewfall was the dominant process in the upper 60cm, distillation in the lower 30cm, and their ratio was about 2 to 1. These ratios are obviously dependent on weather, vegetation-soil conditions, and height of measurement. Duvdevani (10), for instance, measured the dew profile in Israel at eight heights up to one meter above ground surface. In the dry summer months the maximum dewfall occurred at one meter, decreasing downward. During the rainy season, when the ground was wet, the maximum value (distillation effect) was recorded at

3cm above the ground. Most observational systems that measure dew or are affected by it appear to be dominated by the distillation rather than by the dewfall effect because of the height of the sensing surface. The fuel moisture sticks used in the National Fire Danger Rating System (11) are exposed at a standard height of 25.4 cm (10 in) usually within the distillation regime. The Davis-Hughes dew monitoring network uses a standard broad-leafed shrub 50-150 cm high. Two of its five sensors are 5 cm above the ground, with the other three sensors in the lower, middle, and upper portions of the bush. Although the top sensor responds to dewfall, on the whole distillation is the primary agent. Experience indicates that most cooperative observers determine their adjective estimate of dew by looking at condensation on low grasses, again primarily estimating the distillation effect. Therefore, periods following substantial rain amounts should produce reports of heavy or very heavy dew. This is substantiated by the literature. Lloyd (12), for example, found that at 30 cm dew amounts observed 3-4 days since rain were 80 percent of the average observed 1-2 days after rain. 5-6 days after rain, the average dropped to 75 percent; after 7-8 days the average was 48 percent; and at 9 or more days it was about 40 percent.

Forecasters should consider these factors when preparing dew forecasts, and observers should make their visual estimates by determining deposition on low surfaces.

3. METHODS USED TO QUANTIFY DEW CLASSIFICATIONS

In an attempt to resolve the problem of the adjective classification system, Duvdevani dew blocks were installed at a height of 25.4 cm (10 in) over a clipped-grass area in East Lansing, Michigan, from June to late October 1975 (13). Blocks were exposed at sunset and read at sunrise. A tabulation of the season's dew amounts during rainless nights shows a distribution ranging from 0 to 0.35 mm (Figure 1). Nightly amounts most often fell in the 0.11-0.15 mm range (29 percent of total), and in the 0.06-0.10 mm

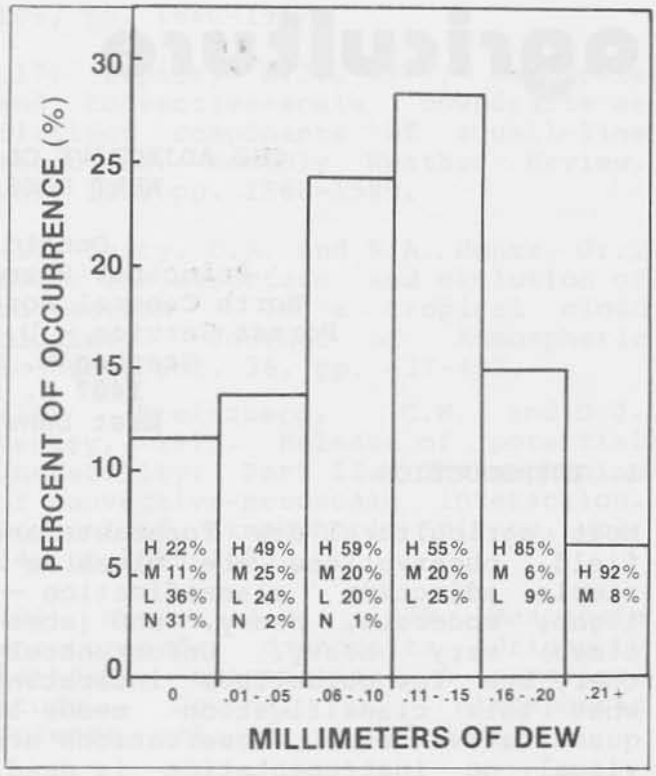

Fig. 1. Frequency distribution of dew amounts determined by the Duvdevani dew blocks, based on 95 rainless night observations, June 21 to November 1, 1975, at East Lansing, Michigan. Concurrent cooperative observers' reports are listed within each of the six groupings. Symbols represent the percent of their reports as: H = heavy, M = moderate, L = light, N = no dew.

category (24 percent). Amounts over 0.20 mm (7 percent) occurred mostly in late June and July. This distribution agrees fairly well with those given by Shaw (4), who also used Duvdevani dew blocks, and with results of other investigators.

The early-morning measurements were compared to visual dew reports routinely sent in by five cooperative observers in the local area, part of Michigan's Agriculture Weather Network (14, 15). Of the 409 dew observations made after rainless nights by the cooperative observers at 0700 EDT, 3 percent were reported as dew-free, 19 percent light, 14 percent moderate, and 64 percent heavy. The majority of adjective reports described dew amounts above 0.05 mm as heavy (Figure 1). Only when the recorded dew amount is less than that figure do adjective

classifications of "moderate" or less predominate. It appears, therefore, that in this subjective reporting system, almost any dew is perceived as a substantial amount.

Interestingly, measurements made during development of the Davis-Hughes instrumentation support these observations. The designers found that dew sensors reached "minimum" saturation with a water depth of 0.07 mm. Minimum saturation was represented by small droplets of water and was visually ranked as moderate to heavy wetting.

4. CONCLUSIONS

Both the weather observers' subjective estimates and the environmental measurements used in calibrating the Davis-Hughes Vegetative Wetting System point to a definition of heavy dew as something in excess of 0.05-0.07 mm. If we define light dew as an amount denoted by the thinnest moisture film, it would mean a nonzero amount of 0.01 mm or less. We can then designate moderate dew as everything between these two amounts. We should consider one additional classification - very heavy dew. This adjective rating is important in such things as fire danger, because it may well preclude night fire occurrence or spread. Work by Haines (13) indicates that this is important when dew amounts are observed in excess of 0.15 mm.

ACKNOWLEDGEMENTS

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REFERENCES AND FOOTNOTES

(1) This article was written and prepared by United States Government employees on official time; it is therefore in the public domain.

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FIFTH ANNUAL MEETING, ST. LOUIS, MO, DECEMBER 1 & 2, 1980:

The Fifth Annual Meeting of the NWA will be held at the St. Louis Bel Air Hilton Hotel, 333 Washington Avenue, St. Louis, MO 63102 on Monday and Tuesday, December 1st and 2nd (Salon Conference Rooms, Lower Level).

Anyone wishing to present a paper should contact:
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The program will be orientated towards operational meteorology.

The meeting will start at 1 p.m., on the 1st, with registration from noon to 1 p.m. The meeting will end about noon on the 2nd. A banquet is planned for the evening of the 1st.

HOUSEKEEPING

Room Registration: Contact the Bel Air Hilton, (314)-621-7900 or call toll-free (800)-325-4620. Mention that you are attending the NWA meeting. A block of rooms has been reserved. Each room contains two double beds. Rates for NWA attendees are $35 for singles, $41 for doubles, plus $9 each for each additional person. Indoor swimming pool available from noon to 10 p.m.

Transportation: Limo service is available between Lambert Field and the downtown hotels about every 20 minutes. Fare is about $5.50.

Social Hour: Prior to the banquet from 6:30 to 7:30 p.m., cash bar.

Banquet: On the evening of December 1 at 7:30 p.m., an NWA Awards Banquet, with a speaker, is planned. Menu choices are Breast of Chicken Montmorenzy ($13.00) or Braised Beef Roast ($13.50), including tax and tip (catered by Trader Vic Restaurants). We need to give the hotel a count for the banquet at least 72 hours ahead of time. If you plan to attend the banquet, please make your check out to :

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Mail check to arrive by November 28th (day after Thanksgiving).

Sightseeing: The Bel Air Hilton Hotel is located at the north edge of downtown St. Louis. Within walking distance are the Gateway Arch and Museum, the Mississippi River Front, Showboats, Old Courthouse, Old Cathedral, Campbell House and Eugene Field Home, live theater, Busch Stadium (in season), numerous restaurants and downtown shopping. After Thanksgiving, relax for a weekend in St. Louis and the surrounding area, then attend the NWA annual meeting.