A SUMMARY OF RAIN INCREASE OPERATIONS IN CENTRAL MICHIGAN DURING THE SUMMERS OF 1972, 1973, AND 1974

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In an earlier paper[1] published in the May 1973 issue of the Weather Modification Journal we detailed the philosophy and principles employed by our group in weather modification operations. In the discussion herein we shall review an operational program conducted in central Michigan for three successive summers -- 1972, 1973 and 1974.

Readers may be curious as to our selection of this particular project. Considerable attention was focused on it by the national media in November 1974 because of a jury trial in Caro, Michigan, resulting from a lawsuit[2] filed by a farmer and his neighbors in Tuscola County. They claimed hail damage to an area located some 60 miles downwind from the eastern boundary of our target area on the afternoon of July 11, 1972, their contention being that this phenomenon was related to our cloudseeding operations in Gratiot County.

The defendants were Irving P. Krick, Inc., of Texas and Sumner Farms, Inc., the latter being our clients in Gratiot County. After a lengthy court trial involving expert witnesses for both the defendants and the plaintiff, the jury ruled in favor of the defendants on all counts. A review of the case appears in this Journal[3].

The cloudseeding project discussed herein involves three counties in central Michigan, namely Gratiot, Montcalm and Isabella. The purpose of the program is to augment natural rainfall during the critical growing months, primarily July and August, in order to increase crop production. Corn is one important crop grown throughout this region. The mode of operation is the same as that used in our other weather modification projects -- i.e., ground-based equipment installed at strategic locations and selectively

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[1] "Applying Ultra Long Range Weather Prediction and Weather Modification to Environmental Management"

[2] Michael Reinbold vs. Irving P. Krick et al. -- File #2734, Tuscola County Circuit Court

[3] "Proof of Legal Causation in Weather Modification Litigation: Michael Reinbold vs. Sumner Farms, Inc. and Irving P. Krick, Inc." by Ray Jay Davis and Pierre St.-Amand

activated. Experienced controllers at our Weather Central in Palm Springs determine seeding potential continuously as derived by specific procedures applied after an examination of ongoing surface and upper air observations of wind conditions, the vertical temperature/moisture profiles and other weather measurements. Appropriate ground units are operated during all favorable weather regimes.

Figure 1 depicts the target area and the ground generator network. The approximate location of the plaintiff's farms north of Caro is also shown. Table 1 summarizes the periods of operation for each summer and the total generator hours by months. The AgI output was 0.5 gm/hr at a rate of about $6x10^{14}$/gm. The cumulative effect of the work during the three summers is depicted graphically in Figure 2 -- a very simple target control type analysis. There is always the possibility of a rainfall pattern that, by chance, would show the target in a more favorable light. However, if such an anomalous pattern were a chance occurrence, it would tend to be cancelled out when cumulative rainfall data for several seasons are examined. In the Gratiot-Montcalm-Isabella County area we have the opportunity to compare the precipitation pattern for three consecutive seasons of operations. Rainfall over the three summer periods (expressed in percent of normal) both inside and outside the target area is shown.

The actual rainfall data are taken from official U. S. Government publications. The normal values plotted are the summations of the long-term July and August normals, which approximate the period of operations. Because cloudseeding programs have been carried out in many areas of the Nation since the early 1950's, the reference normals used in our analyses are those established prior to that time, so that any effect of cloudseeding on the data is removed.

The model plotted at each official reporting station is as follows:

$$\frac{\text{Actual Precipitation}}{\text{Normal Precipitation}} = \text{Percent of Normal Precipitation}$$

It can be noted that an area of maximum rainfall is located within the target. Montcalm, Gratiot and Isabella Counties received from 50% to 90% more moisture than upwind areas to the south, the direction from which airstreams arrive and are treated for rain enhancement over the project.

Thus the composite for the three seasons provides a data interval from which a meaningful assessment of the effects of cloudseeding can be made. Precipitation totals were typically erratic across Michigan during each individual season. However many of these variabilities were smoothed out in the composite.

Statements by various farmers at the court trial confirmed that crops were substantially above normal during the years reviewed in this summary. The increased in corn yields were of the same order as the rainfall departures from historical normals.

Mr. John Baker, Director of the County Extension Service for Gratiot

County, reported that corn yields on his 800-acre farm were approximately 80 bu/acre before cloudseeding and were much higher during cloudseeding years -- being 160 bu/acre in 1972, 120 bu/acre in 1973, and 130 bu/acre in 1974. Mr. William Bigelow, President of Sumner Farms, Inc., reported similar results, as did several other farmers from Gratiot County.

Thus, while the information dispensed by the media may have inferred that cloudseeding operations are inconclusive because the court action confirmed that there was no effect at the plaintiff's farms, the analysis of rainfall and crop data for a three year period reveals that the cloudseeding program in central Michigan is producing results of high economic value.

TABLE 1

Summary of Operational Data for
Central Michigan Projects

OPERATING INTERVALS

1972: June 12 - 15, June 19 - 20,
June 26 - July 15, and
July 25 - August 17

1973: June 22 through August 31

1974: June 29 through September 3

HOURS OF OPERATION

	1972	1973	1974
June	318:15	120:00	26:00
July	673:00	876:30	530:30
August	416:00	521:45	1267:00
September	0	0	158:30

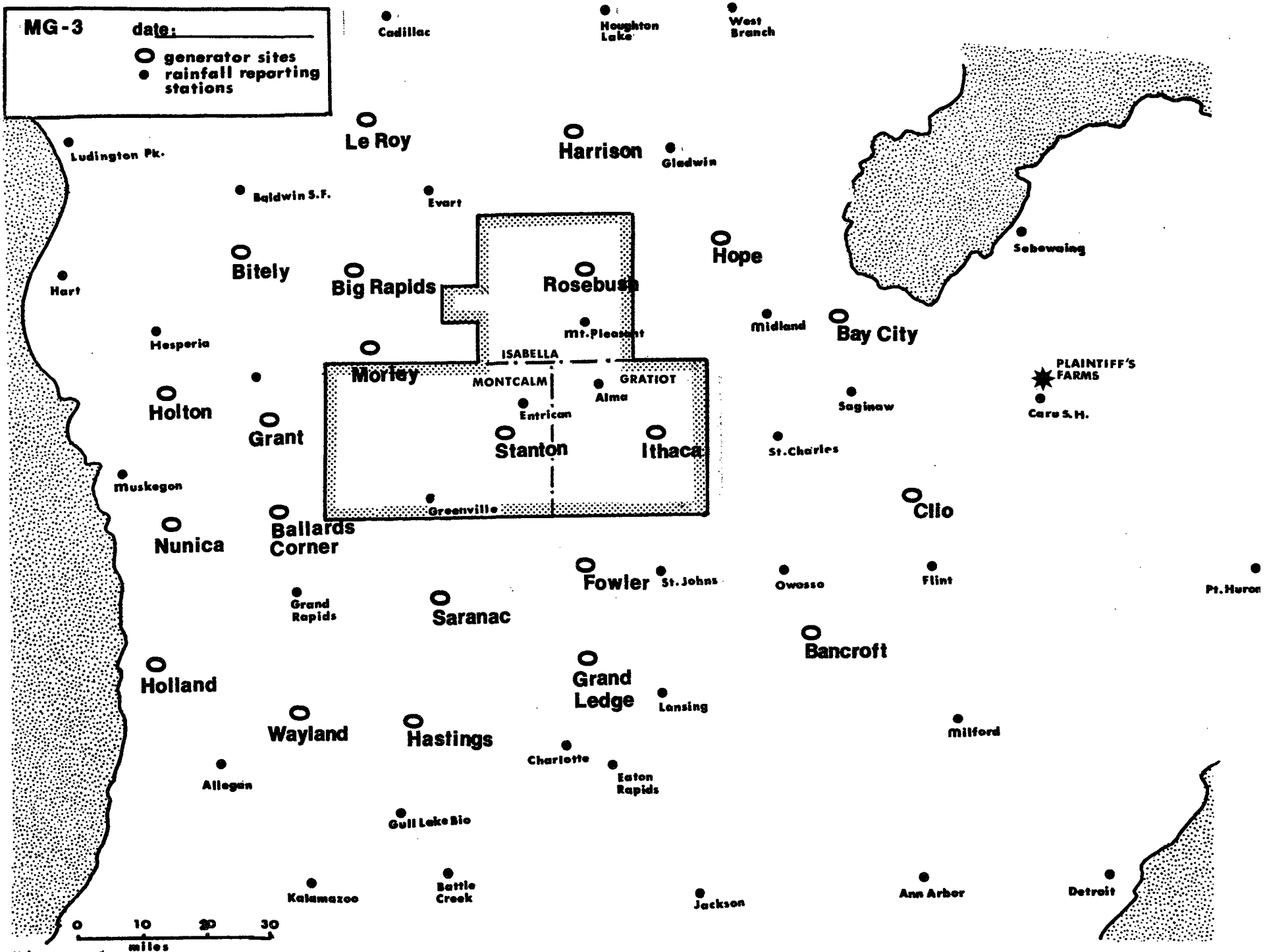
MG-3
date:
generator sites
rainfall reporting stations
Cadillac
Houghton Lake
West Branch
Le Roy
Harrison
Gladwin
Ludington Pk.
Baldwin S.F.
Evart
Sebewaing
Bitely
Big Rapids
Rosebush
Hope
Hart
Midland
Bay City
Hesperia
Mt. Pleasant
ISABELLA
Morley
MONTCALM
GRATIOT
Alma
PLAINTIFF'S FARMS
Holton
Entrican
Saginaw
Caro S.H.
Grant
Stanton
Ithaca
St. Charles
Muskegon
Greenville
Clio
Nunica
Ballards Corner
Fowler
St. Johns
Owosso
Flint
Pt. Huron
Grand Rapids
Saranac
Bancroft
Holland
Grand Ledge
Lansing
Wayland
Hastings
Milford
Charlotte
Eaton Rapids
Allegan
Gull Lake Bio
Kalamazoo
Battle Creek
Jackson
Ann Arbor
Detroit
0 10 20 30
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Figure 1

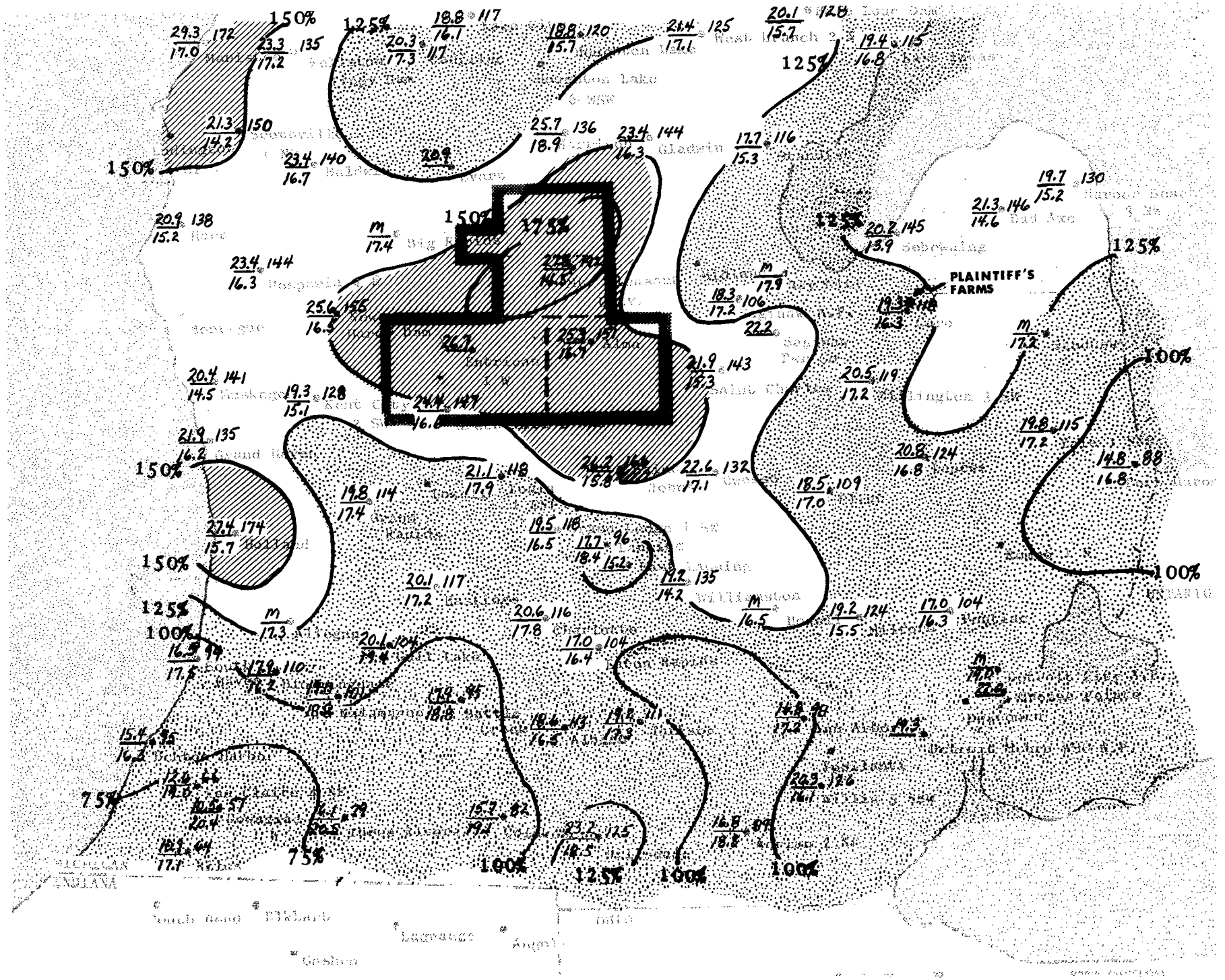

Figure 2 Composite precipitation analysis --- operational periods of 1972, '73 and '74