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SHORT RANGE FORECASTING OF DRYOFF TIME FROM DEW BLOCK DEW INTENSITY

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ABSTRACT

Dryoff time of morning dew is a critical factor for many agricultural field operations. Forecasting this time is one of the duties of the agricultural forecasting staff at WBAS, Memphis, Tennessee. The Mid-South area of responsibility presently includes the state of Arkansas, West Tennessee, Missouri Zone 13 (which includes the Missouri Bootheel), the Louisiana Delta, the Mississippi Delta, and Northeast and North-central Mississippi. (Fig.1)

A network of dew blocks was located over portions of the forecast area from which daily reports of dew intensity, and when possible of actual dryoff time of dew, were made. At WBASO, Jackson, Tennessee, a dew block was located with defoliated cotton from which daily reports of dew intensity and of dryoff time on defoliated cotton were made. Statistical analysis furnished linear regression lines from which forecast time of dew dryoff on either or both the dew blocks themselves or of defoliated cotton plants could be made. Data utilized in this study were for September and October 1966 and for late August and early September 1967.

The forecasting success to date, from the results achieved, opens the door to further investigations in this area.

INTRODUCTION

Earlier efforts by Newton and Riley (1) in the Mid-South in which they used Duvdevani type dew blocks (2) to investigate areal and vertical variations of dew over the area were used as a basis for this approach to the study of developing a forecasting technique for the dryoff time of dew.

Such a technique, for obvious reasons, required three main factors:

1. Minimum expense in an observing and reporting network.
2. Ease of usage by the agricultural forecaster.
3. Reliability in the result.

This report describes a technique which, although limited to results on dew blocks themselves and to defoliated cotton, meets all three requirements.

OBSERVING AND REPORTING NETWORK

The Duvdevani type dew block offers not only the advantage of providing sufficiently reliable data on dew intensity, but it is of a design that can be reproduced locally in sufficient quantity at a relatively negligible expense. For this reason it was selected for the purposes of this study.

In order to gain daily information where possible, efforts were made first to utilize the existing cooperative observers that were reporting daily to Memphis. These included several state agricultural experiment stations. Our initial network covered portions of the North Half of Mississippi, West Tennessee, portions of Northeast Arkansas, and the Missouri Bootheel. Each observer was furnished with a dew block located at a 24-inch height and with a set of nine photographs providing a pictorial description of the nine variations of dew intensity, (light) L1, L2, L3, (moderate) M1, M2, M3, and (heavy) H1, H2, H3. With this material each observer was able to furnish WBAS, Memphis with a daily report of dew intensity, and where it was practical and did not inconvenience the observer, we were also furnished, usually on a following day basis, the actual dryoff time of the dew on the dew block.

In addition, the dew block furnished to WBASO, Jackson, Tennessee, was located by the agricultural meteorologist at a 24-inch height in defoliated cotton and data on 30 observations were furnished showing dew intensity and the corresponding dryoff time of the defoliated cotton.

DEVELOPMENT OF A FORECAST TECHNIQUE

As an initial step, data from 74 observations throughout the network gave both dew intensity and dryoff time on the dew block. These data were analyzed and from it a linear regression line was computed using the method of least squares. Two assumptions were made in this analysis: (1) that there was a linear progression in dew intensity from L1 to H3, and (2) minimal time variations experienced because most observers had to check observations each fifteen or thirty minutes rather than staying right with the dew blocks each morning had a tendency to compensate themselves. Both of these assumptions seemed reasonable for our purposes. Statistically a coefficient of correlation of .75 was determined. Our next step was to determine a standard error of estimate which proved to be 27 minutes. This value seemed slightly large; however, through necessity, we were required to explore data from the overall area. Future studies based on larger samples from individual segments of the overall area should furnish smaller values by delineating geographical variations. By advancing our regression line to a 54-minute later time (two times the value of the standard error of estimate), we determined a dryoff time when we could expect all (with approximately 98% confidence) of the dew blocks in the field to be dry. This initial step was important to us because once we could reliably forecast the dryoff time of dew on the dew block, we felt we could proceed in attempting to relate this dryoff time to agricultural crops. (See Fig. 2)

Data from the 30 field observations at Jackson, Tennessee, were then analyzed and from it a linear regression line was developed relating the dryoff time on defoliated cotton to dew intensity on the dew block.

Again, the same two assumptions as in the first analysis were made. Statistically an r value of .72 was determined. A smaller standard error of estimate of 24 minutes was determined which seemed quite reasonable for all observations from a single location. By advancing our regression line 48 minutes we determined a dry-off time (with approximately 98 percent confidence) when we could expect defoliated cotton in the field to be dry. (See Fig. 3)

By superimposing one regression line upon the other a relatively minimal difference was indicated. Defoliated cotton lagged the dry-off time of the dew block by 12 minutes at the L1 intensity, was identical between M2 and M3 intensity, and led the dew block dryoff time by 9 minutes at H3 intensity. (See Fig. 4)

Statistical tests were made to confirm the linear relationships established for both sets of data. As a further confirmation, upon completion of our study we were fortunate enough to have our data run on an IBM 1622 computer at Memphis State University. The results of this computer run substantiated our findings and again confirmed the linear relationships established.

FURTHER INVESTIGATIONS

While we feel that our work to date is an important step forward in this area and provides our station with a basis for forecasting dry-off time of dew on defoliated cotton, we recognize the need to relate this method to other major crops such as undefoliated cotton, soybeans, etc. At the same time, it would seem that such investigations, because of the increased leaf surface of these crops, might better lend itself to curvilinear regression techniques,or because some other variables might be of increasing importance to multiple regression techniques. However approached, we can see definite advantages to relating such studies to dew intensities as determined by the Duvdevani type dew block so that a standardization of definition might be achieved with respect to the various dew intensities.

CONCLUSION

Dry-off time of defoliated cotton can be related to dew intensities as determined by the Duvdevani type dew block. Linear regression techniques can develop a simple graph from which the agricultural forecaster in the station can forecast the dry-off time of defoliated cotton for his area of concern.

ACKNOWLEDGMENTS

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WBAS MEMPHIS AREA FOR WHICH AGRICULTURAL FORECASTS ARE ISSUED

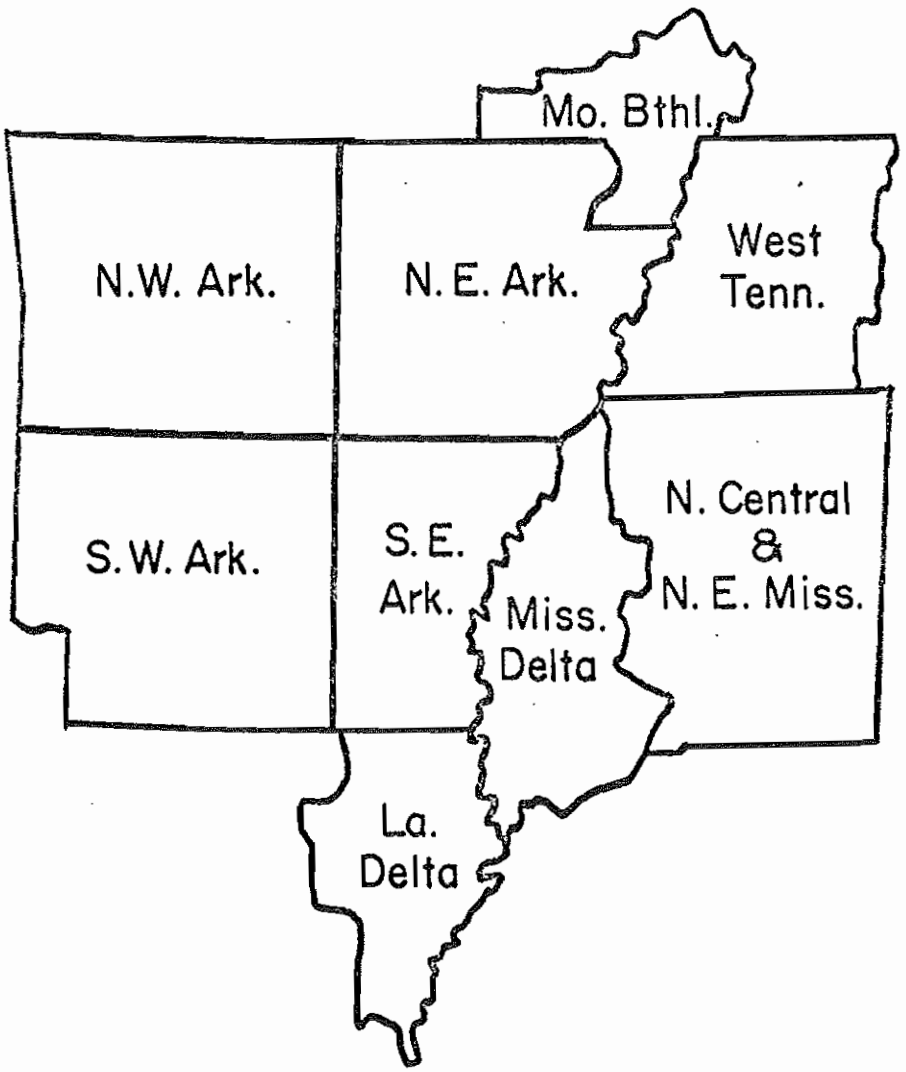


FIGURE 1

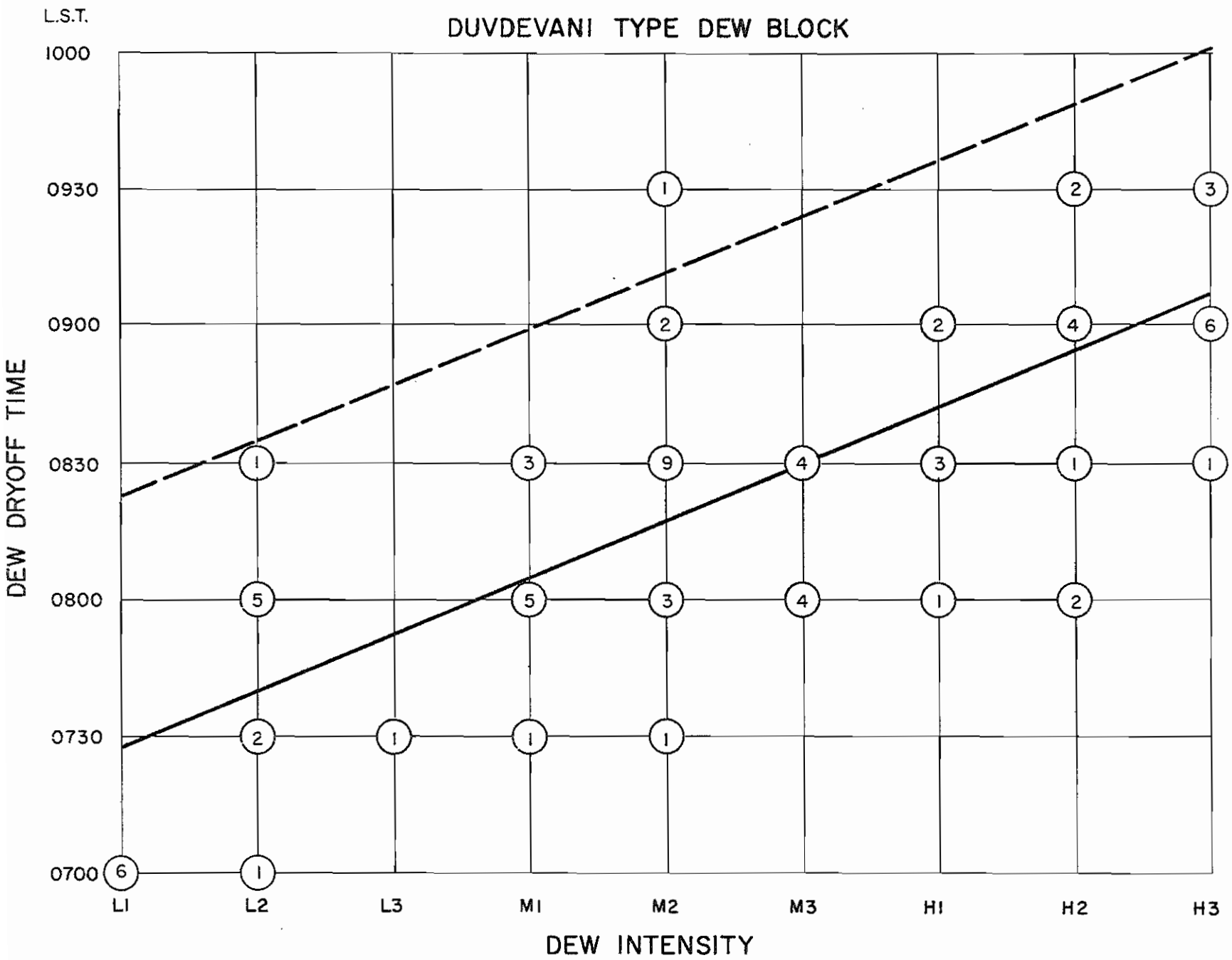
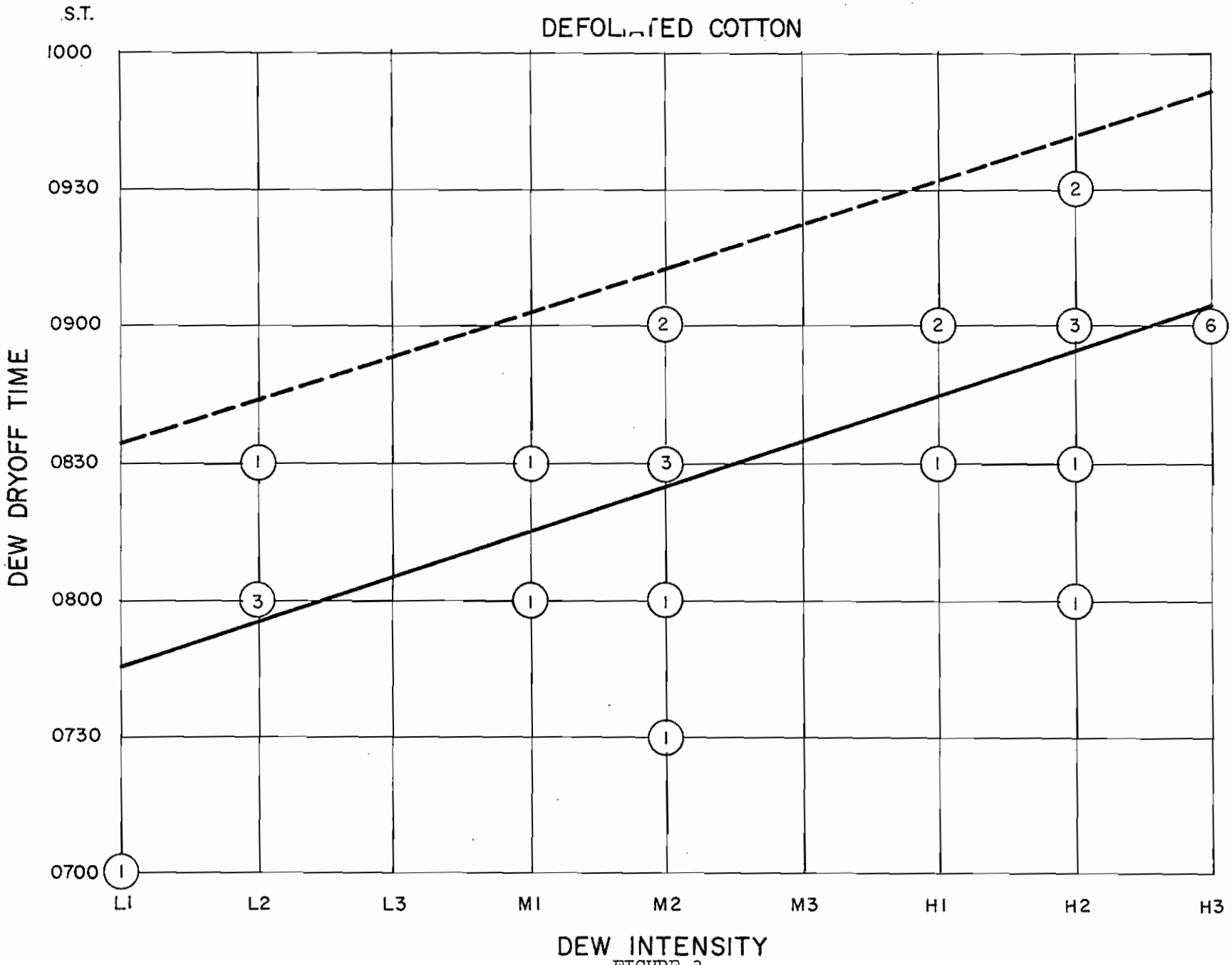

DUVDEVANI TYPE DEW BLOCK
L.S.T.
1000
0930
0900
0830
0800
0730
0700
DEW DRYOFF TIME
L1
L2
L3
M1
M2
M3
H1
H2
H3
DEW INTENSITY

FIGURE 2


S.T.
DEFOLIATED COTTON
1000
0930
0900
0830
0800
0730
0700
DEW DRYOFF TIME
L1
L2
L3
M1
M2
M3
H1
H2
H3
DEW INTENSITY
FIGURE 3

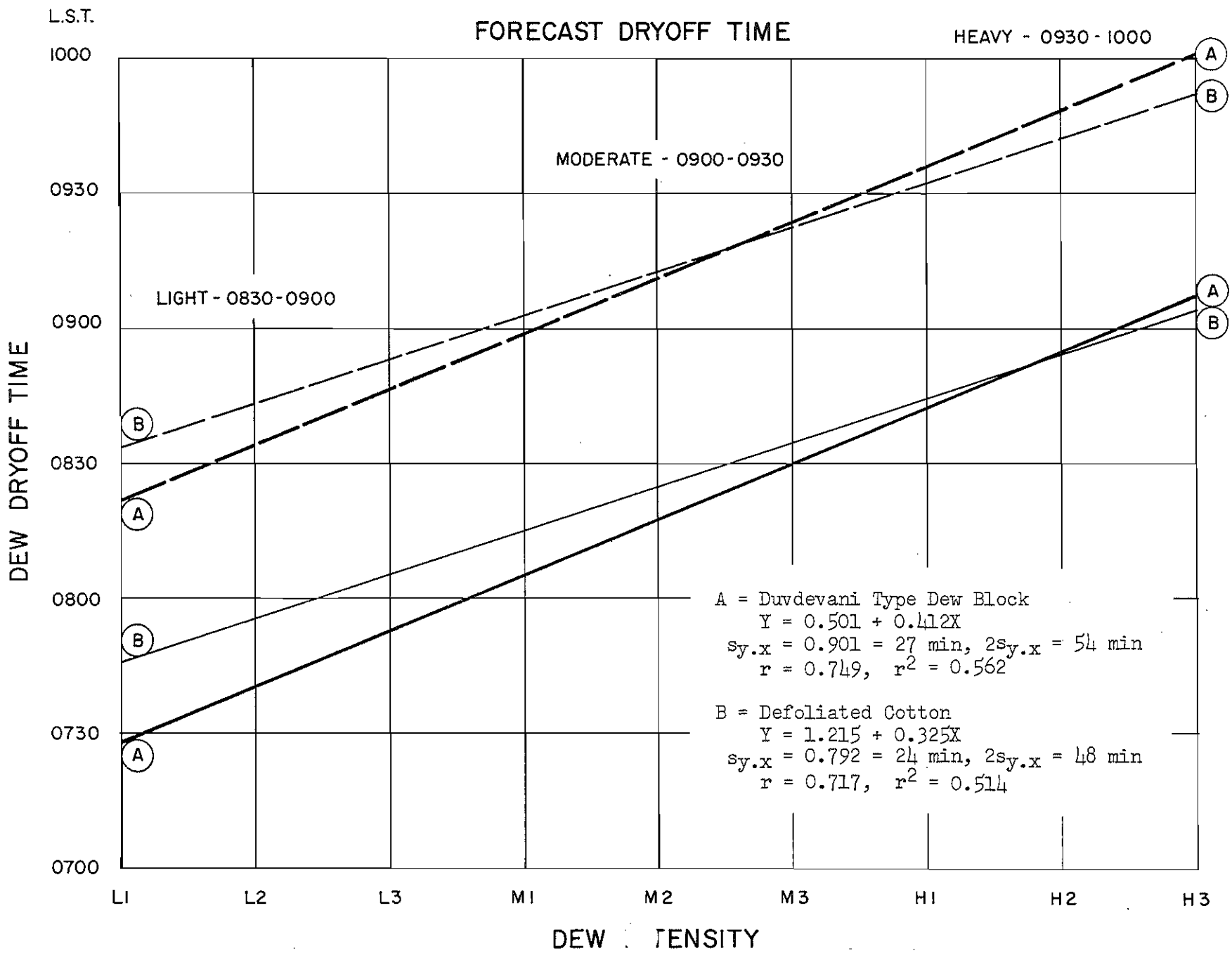

FORECAST DRYOFF TIME
L.S.T.
1000
0930
0900
0830
0800
0730
0700
DEW DRYOFF TIME
HEAVY - 0930 - 1000
MODERATE - 0900 - 0930
LIGHT - 0830 - 0900
A
B
L1
L2
L3
M1
M2
M3
H1
H2
H3
DEW DENSITY
A = Duvdevani Type Dew Block
Y = 0.501 + 0.412X
$s_{y.x}$ = 0.901 = 27 min, $2s_{y.x}$ = 54 min
r = 0.749, r^2 = 0.562
B = Defoliated Cotton
Y = 1.215 + 0.325X
$s_{y.x}$ = 0.792 = 24 min, $2s_{y.x}$ = 48 min
r = 0.717, r^2 = 0.514

FIGURE 4

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