Planting Date and Susceptibility to Pink Bollworm

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ABSTRACT

The susceptibility of cotton to spring emergence of pink bollworm (PBW) was evaluated for a variety of planting dates in Pinal, Maricopa, LaPaz and Yuma counties using historical climate records and heat-unit-based models that predict PBW emergence and cotton development. Early planted cotton proved most susceptible to the PBW emergence, however, cotton type (short vs. long staple) and springtime weather conditions both played an important role in overall susceptibility.

INTRODUCTION

Control of pink bollworm (PBW) is most successfully accomplished using a combination of cultural and chemical control. One aspect of cultural control involves making adjustments in planting date to minimize the survival of early season PBW larvae. Low survival in this initial larval population reduces the size of subsequent generations, making control of PBW less difficult and costly.

The PBW overwinters in a dormant, larval form. As weather conditions warm in the late winter and early spring, overwintering PBWs complete their life cycle and emerge as adults. Upon emergence, the female moths lay eggs which produce the next generation of PBW larvae. The survival of this new generation is heavily dependent on whether the young larvae find cotton that has developed squares 1/3 of full size or larger (defined as the susceptible square stage). Younger cotton provides inadequate food and shelter, resulting in poor survival of larvae. Planting date affects when cotton reaches susceptible square and therefore can have a major impact on the survival of early season PBW larvae.

To conduct a quantitative assessment of how planting date impacts the susceptibility of cotton to early season PBW larvae, one must carefully examine early season weather conditions. Huber (1) has shown that spring emergence of PBW can be predicted using heat units (Figure 1), a parameter calculated from daily maximum and minimum temperatures. Huber also has found that the accumulation of heat units between planting and susceptible square is relatively constant for short and long staple cotton (900 and 1100 heat units respectively). Since both early season cotton development and spring emergence of PBW are closely related to heat unit accumulation, an analysis of springtime temperature patterns should provide a means for evaluating the effectiveness of using adjustments in planting date to assist in control of PBW. In this report we present the results of such an analysis conducted for the major cotton growing regions of Pinal, Maricopa, LaPaz and Yuma counties.

METHODS

Historical climate records for the major cotton growing areas of Pinal, Maricopa, LaPaz and Yuma counties were obtained from the Office of the State Climatologist. Length of the historical records varied from 24 to 30 years depending on location. Annual accumulations of heat units (temperature thresholds = 86F and 55F) were computed for each year of record for all locations. The warmest and coldest springs were selected for each location and designated as the historical hot and cold years respectively. The mean annual accumulation of heat units was also computed for each location to serve as the normal year. Springtime PBW emergence curves (e.g.

Fig. 1) were then generated for the hot, cold and normal years for all locations using the equation presented by Huber (1).

Seven planting dates encompassing the first six weeks of the cotton planting season were then evaluated for susceptibility to emerging PBWs during hot, cold and normal years. For each planting date the heat unit accumulation since 1 Jan. was determined for the cold, normal and hot years. Next, the heat unit accumulation (since 1 Jan.) at susceptible square for short and long staple cotton was determined for each plating date by adding 900 and 1100 heat units respectively to the heat unit accumulation at planting. The heat unit accumulations at susceptible square were then transferred to the correct PBW emergence curves to determine the percentage of PBW emergence remaining after susceptible square.

RESULTS AND DISCUSSION

The results of the planting date/PBW susceptibility analysis are presented for each location in Tables 1 and 2. The numbers presented represent the percentage of PBW spring emergence remaining after cotton has reached susceptible square. Thus, larger numbers in Tables 1 and 2 indicate higher levels of susceptibility to PBW spring emergence. Average countywide susceptibility is depicted graphically in Figures 2-5.

Planting date, cotton type (short or long staple) and springtime weather conditions all play a role in determining the susceptibility of cotton to PBW spring emergence. Short staple cotton proved more susceptible than long staple cotton for a given planting date because it reaches susceptible square more quickly (lower heat unit requirement). Regardless of cotton type, however, earlier planting dates were more susceptible to PBW emergence (Figures 2-5) with the highest susceptibility occurring in western Yuma Co. where the legal first planting date is 15 Feb. (Figure 5).

Susceptibility of cotton to PBW also was quite sensitive to springtime weather conditions. For a given planting date, cotton was found to be most susceptible in cold springs and least susceptible in hot springs (Figures 2-5). In many cases the effect of springtime weather on susceptibility was quite large. Short staple cotton planted 29 Mar. in Buckeye offers an excellent example of this large weather effect. Susceptibility to PBW ranged from 47% for the cold spring to only 11% during the hot spring (Table 2).

SUMMARY

Adjustments in planting date can significantly lower the susceptibility of cotton to PBW spring emergence. However, cotton type and springtime weather conditions play a major role in determining the overall susceptibility of a given planting date. Growers wishing to incorporate planting date into their PBW control program should keep abreast of early season weather conditions. Weather information specifically tailored to the planting date/PBW emergence question is available from the Arizona Meteorological Network operated by Arizona Cooperative Extension (2).

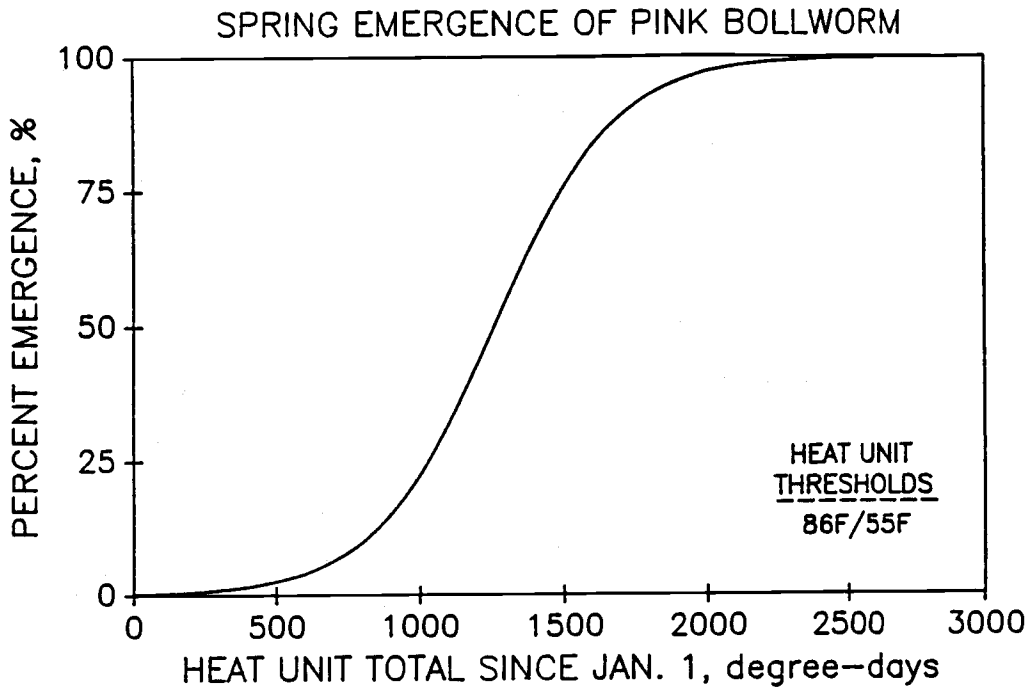

Figure 1. Spring emergence of PBW as a function of the annual accumulation of heat units (after Huber (1)).

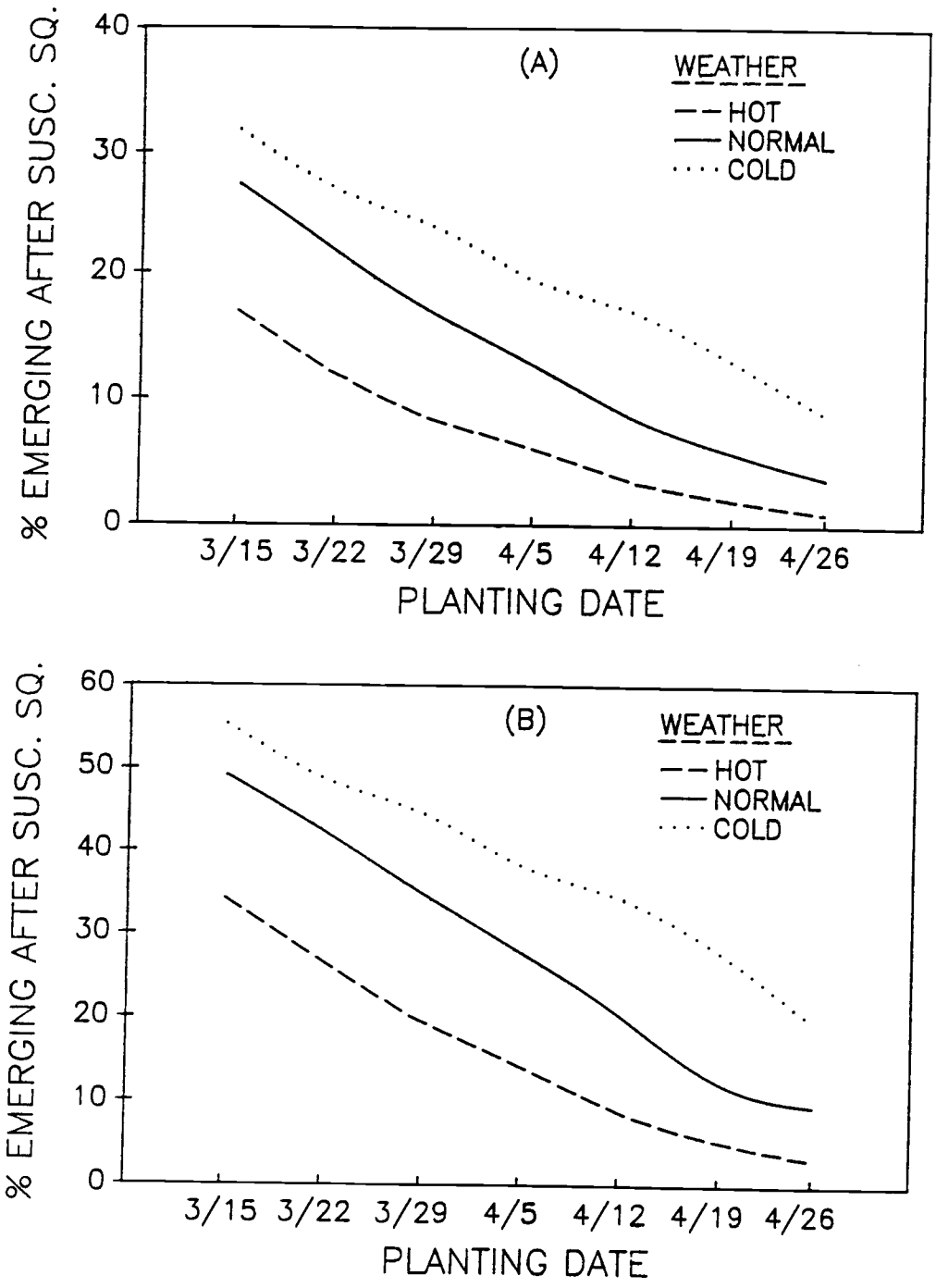

Figure 2. Mean percentage of spring PBW emergence occurring after susceptible square as a function of planting date and weather conditions for long staple (A) and short staple (B) cotton in Pinal County. Countywide mean values were obtained by averaging the location-specific values presented in Tables 1 and 2.

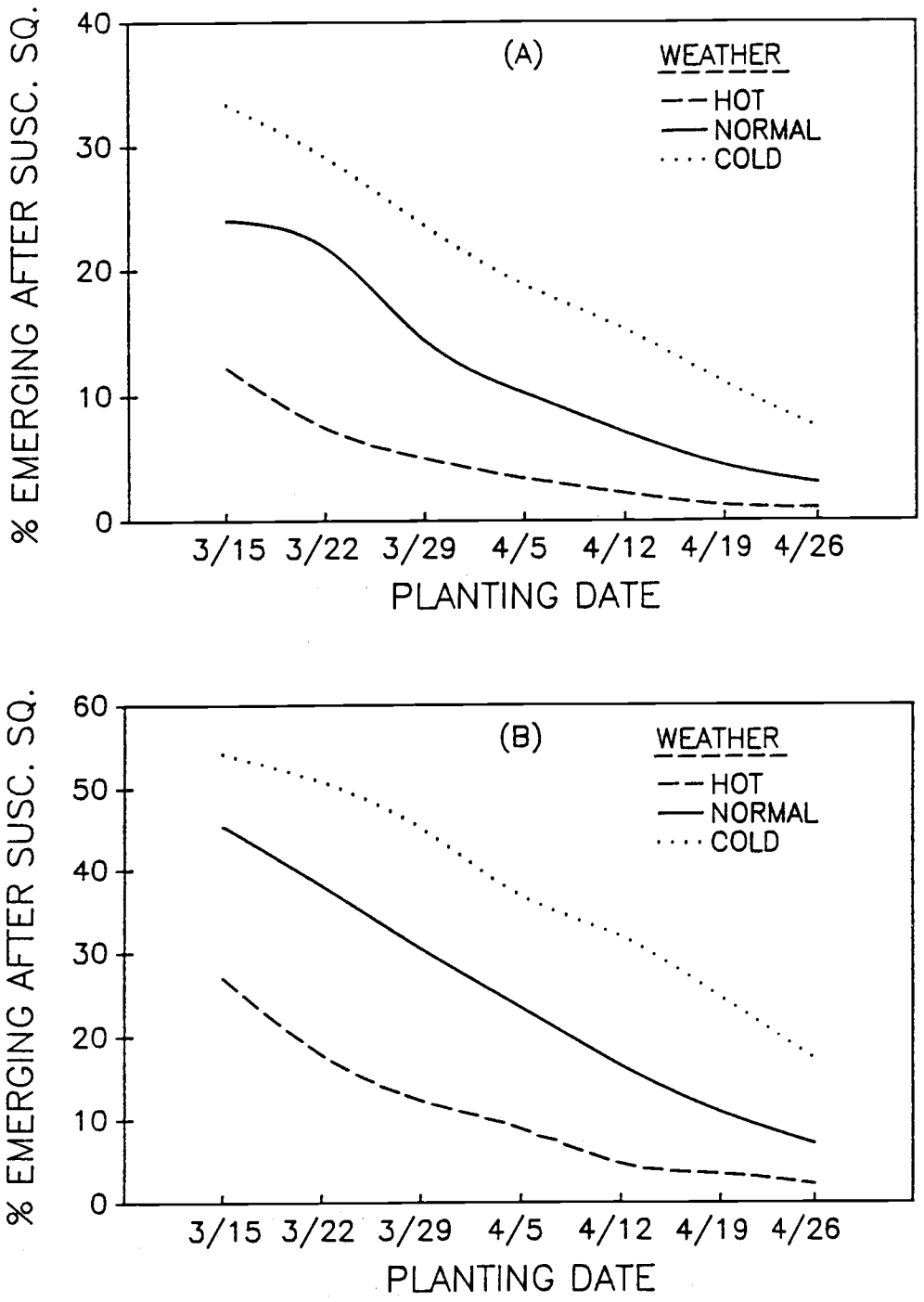

Figure 3. Mean percentage of spring PBW emergence occurring after susceptible square as a function of planting date and weather conditions for long staple (A) and short staple (B) cotton in Maricopa County. Countywide mean values were obtained by averaging the location-specific values presented in Tables 1 and 2. Note, Aguila not included in countywide averages due to significant differences in temperature relative to other Maricopa County locations.

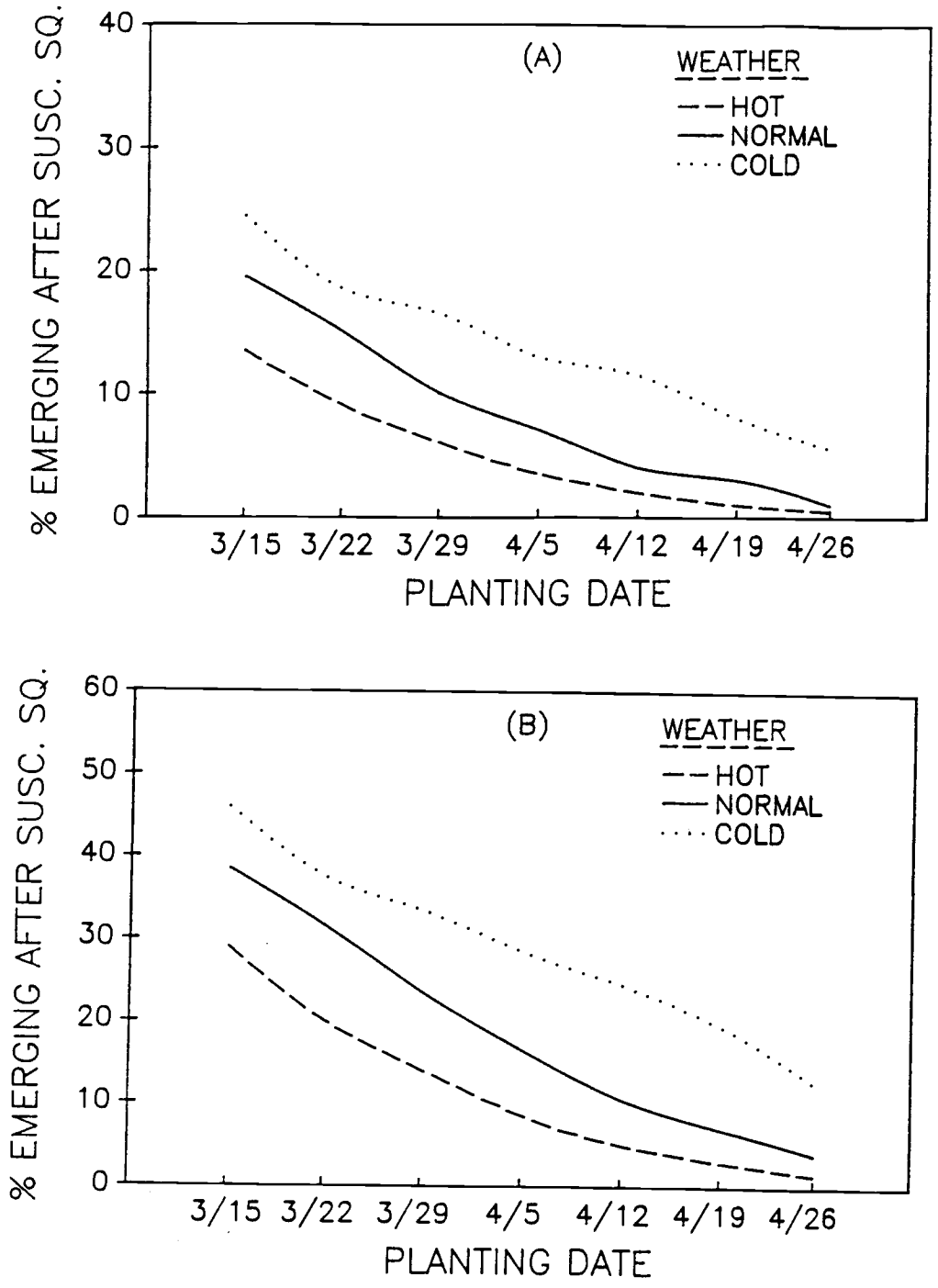

Figure 4. Mean percentage of spring PBW emergence occurring after susceptible square as a function of planting date and weather conditions for long staple (A) and short staple (B) cotton in LaPaz County. Countywide mean values were obtained by averaging the location-specific values presented in Tables 1 and 2.

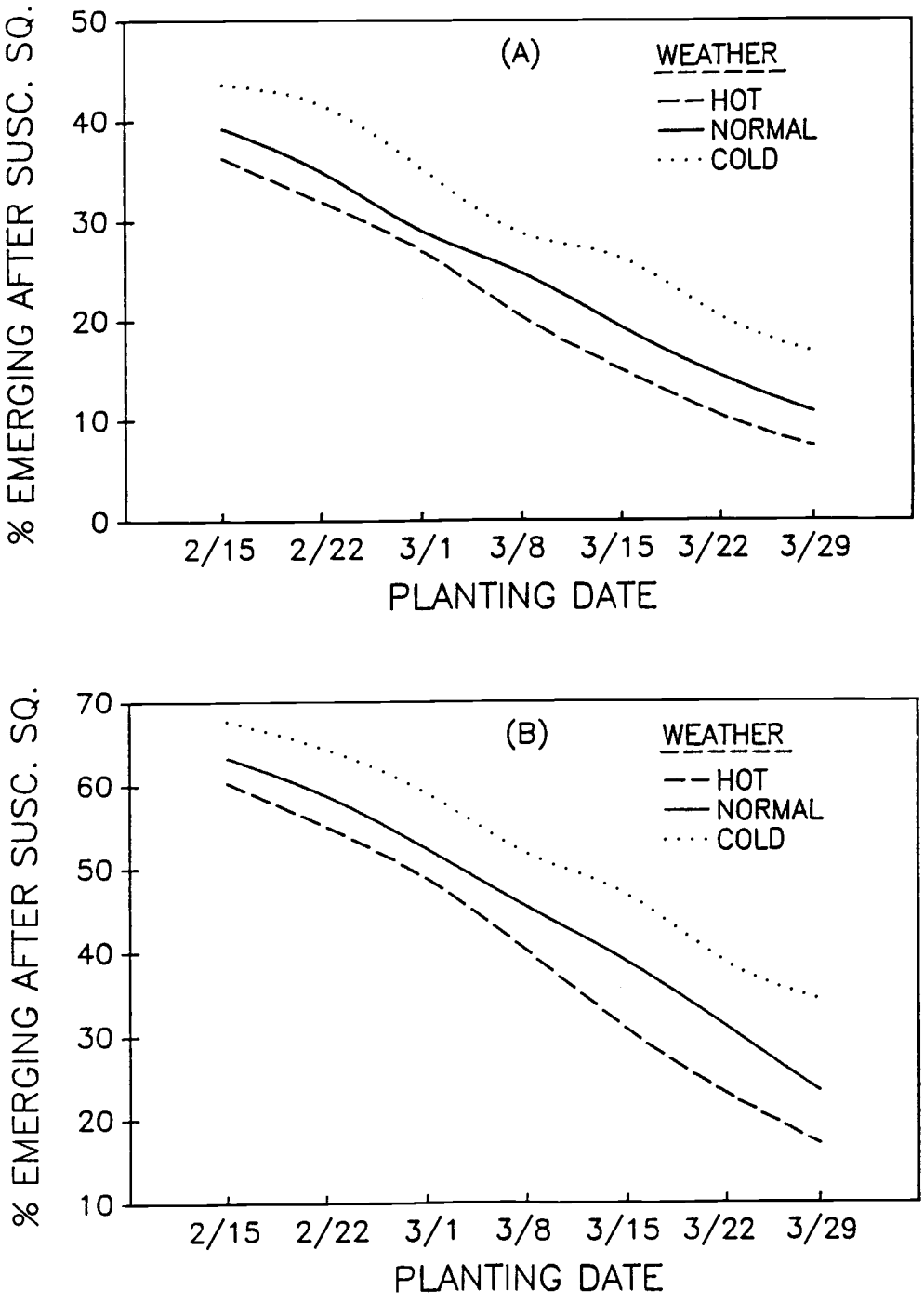

Figure 5. Mean percentage of spring PBW emergence occurring after susceptible square as a function of planting date and weather conditions for long staple (A) and short staple (B) cotton in Yuma County. Countywide mean values were obtained by averaging the location-specific values presented in Tables 1 and 2.

REFERENCES

1. Huber, R.G. 1982. Heat units and population prediction. In Proc. 1982 Beltwide Cotton Production Mechanization Conf. 6-7 Jan. 1982. Las Vegas, NV.

2. Brown, P.W. 1989. Accessing the Arizona Meteorological Network by Computer. Extension Rpt. 8733. Univ. of Arizona, College of Agric.

ACKNOWLEDGEMENT

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	PLANTING DATE																				
	March 15			March 22			March 29			April 5			April 12			April 19			April 26		
	H	N	C	H	N	C	H	N	C	H	N	C	H	N	C	H	N	C	H	N	C
Maricopa Co.																					
AGUILA	34	39	42	31	37	39	26	32	37	22	28	34	17	22	29	12	18	22	8	14	17
BUCKEYE	12	24	36	7	19	30	5	14	25	3	10	20	2	7	15	1	4	10	1	3	6
CHANDLER	15	28	33	10	22	25	6	18	23	4	12	21	3	9	18	2	6	15	1	4	11
GILA BEND	11	20	27	6	16	22	5	11	17	3	8	13	2	5	11	1	3	7	1	2	4
LAVEEN	12	25	30	7	19	23	5	15	21	4	11	17	2	7	15	1	5	12	1	3	8
LITCHFIELD PK.	11	23	41	7	18	36	4	14	32	3	10	23	2	7	17	1	4	11	1	3	8
Pinal Co.																					
CASA GRANDE	19	27	31	15	21	27	11	16	22	8	11	19	5	7	17	3	5	13	1	3	9
COOLIDGE	18	26	27	14	20	21	11	16	19	7	12	16	4	8	13	2	5	10	1	3	7
ELOY	20	26	42	15	20	36	10	16	36	8	12	30	5	8	25	3	5	19	1	3	13
FLORENCE	13	28	27	8	22	23	5	17	19	4	13	16	2	9	14	1	7	11	1	4	7
MARICOPA	15	29	31	9	25	26	6	19	22	4	15	18	2	10	16	1	6	12	1	5	9
SACATON	17	28	33	11	22	28	7	17	25	5	13	18	3	9	17	2	6	13	1	4	8
LaPaz Co.																					
EHRENBERG	10	19	23	6	15	17	4	10	15	2	7	12	1	4	10	1	3	7	0	1	5
PARKER	17	20	26	12	15	20	8	10	18	5	7	14	3	4	13	1	3	9	1	1	6

	PLANTING DATE																				
	Feb. 15			Feb. 22			March 1			March 8			March 15			March 22			March 29		
	H	N	C	H	N	C	H	N	C	H	N	C	H	N	C	H	N	C	H	N	C
Yuma Co.																					
WELLTON	40	42	44	35	38	42	31	32	36	24	28	29	19	22	27	14	17	21	10	13	17
YUMA MESA	32	37	41	27	32	39	21	26	31	15	21	23	10	16	20	6	12	16	4	8	13
YUMA VALLEY	37	39	46	34	35	44	29	29	39	22	25	34	16	20	32	11	14	24	8	11	20

Table 1. Effect of planting date on susceptibility of long staple cotton to spring PBW emergence for hot (H), normal (N) and cold (C) years. Numbers presented represent the percentage of PBW emergence occurring after susceptible square.

	PLANTING DATE																			
	March 15			March 22			March 29			April 5			April 12			April 19			April 26		
	H	N	C	H	N	C	H	N	C	H	N	C	H	N	C	H	N	C	H	N	C
Maricopa Co.																					
AGUILA	58	64	65	53	59	64	47	54	62	42	49	59	34	44	52	24	37	42	17	28	34
BUCKEYE	27	45	59	18	38	55	11	30	47	8	22	39	4	16	30	3	11	23	2	7	16
CHANDLER	32	50	54	21	43	49	15	36	46	11	28	40	6	20	38	4	14	33	3	9	23
GILA BEND	24	41	48	15	32	44	12	26	37	8	19	27	4	12	24	3	8	17	2	5	10
LAVEEN	27	47	52	18	40	46	12	31	41	9	25	35	5	18	33	4	11	25	2	7	19
LITCHFIELD PK.	25	44	65	17	37	60	11	29	55	8	23	43	4	16	34	3	10	25	2	7	18
Pinal Co.																					
CASA GRANDE	39	47	55	32	40	47	25	33	45	17	25	39	11	18	34	7	12	29	4	8	20
COOLIDGE	37	47	49	31	40	42	24	32	36	17	26	31	11	19	29	6	13	23	3	9	16
ELOY	37	48	64	31	41	61	23	34	59	18	26	54	12	19	44	6	12	36	4	8	27
FLORENCE	28	50	50	19	43	42	13	36	40	10	30	32	5	22	30	4	16	23	3	11	16
MARICOPA	31	52	55	21	45	47	15	38	42	10	31	36	7	23	34	4	16	28	2	11	20
SACATON	33	51	56	25	44	53	17	35	45	13	28	37	7	21	35	5	14	28	3	10	18
LaPaz Co.																					
PARKER	36	39	49	27	32	40	19	24	37	11	17	32	7	10	26	4	7	22	2	4	14
EHRENBERG	23	38	43	13	31	35	9	23	30	6	16	25	3	11	23	2	7	17	1	4	11

	PLANTING DATE																			
	Feb. 15			Feb. 22			March 1			March 8			March 15			March 22			March 29		
	H	N	C	H	N	C	H	N	C	H	N	C	H	N	C	H	N	C	H	N	C
Yuma Co.																					
WELLTON	64	66	68	60	62	66	54	56	60	45	49	52	38	42	47	29	36	39	23	28	36
YUMA MESA	56	61	65	49	55	61	41	48	55	32	41	44	22	35	39	15	26	31	10	19	28
YUMA VALLEY	61	63	70	56	59	66	51	53	62	43	46	59	32	39	54	25	31	46	18	23	39

Table 2. Effect of planting date on susceptibility of short staple cotton to spring PBW emergence for hot (H), normal (N) and cold (C) years. Numbers presented represent the percentage of PBW emergence occurring after susceptible square.