United States Department of Agriculture
Forest Service
Helena National Forest
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Helena, MT 59626

1304

REPLY TO: 2550
1920

Date: 2/24/87

SUBJECT: REGENERATION STUDY - SOIL MOISTURE AND TEMPERATURE IMPLICATIONS

TO: STAFF AND DISTRICT RANGERS

May 1984 Dick Schwecke and I set up a paired study to try to answer the question, what kills tree seedlings on hot dry sites. Whether the droughty nature of the soils, the high evapotranspiration levels the sites required, or the temperature due to high solar radiation, was the primiary cause of seedling death.

METHODS:

Two study sites were picked one in Whiteman Creek and the second in Ophir Creek. Both were areas where a number of planting failures had occurred. The habitat type at the Whiteman Creek site is PIPO/AGSP on a southeast aspect and at the Ophir Creek site PSME/CARU on a south aspect. At each site three soil tempreature and moisture monitoring stations were installed. Two stations were put in a unvegetated area of the clearcut. One with no shading and the other with two shade cards at the base of the station. The third station was put in a natural stand as close as possible to the clearcut. Soil moisture was measured using gypsum blocks at 6 and 12 inches. Soil temperature was measured with a metal thermometer at the surface and at 3 inches, and at 12 inches with a thermistor.

Measurements were taken on a non-scheduled basis as early in the spring as the roads were passable until the soil moisture was depleted from the site. No readings were taken in 1985 due to a severe early season drought.

RESULTS:

Soil moisture levels for the two sites are graphed on pages 3 thru 10. Bars tension are used to reflect the plants work to get the soil water. Fifteen bars is considered wilting point for plants and 1/3 bar is the soil's feild capacity or very near saturation. A value of 3 bars is considered roughlly when most tree seedlings become stressed. Calander day reflects the Julian date.

"A common guideline for soil moisture requirements for survial of transplanted seedlings is given by Krueger and Trappe (1967). They estimate that seedlings will survive if they have an adequate supply of soil water for a 28 days following transplanting."(1) Childs states that over a 6 week period, "transplanted seedlings change components of the plant water balance in order to survive in the transplanted environment. The most marked adjustments are a decreased shoot to root ratio and decreased stomatal conductance."(1). In other word if the seedling is not stessed in the first 28 to 42 day, it has adapted to it new environment and has a better chance of withstanding moisture stress at that time.

One can assumes that normally most transplanting on warm dry sites will start to occur about May 1. Therefore on both study site in 1984 there was 75 days from the start of the planting season until the soil reached a

moisture tension of 3 bars. In 1986 the Ophir Creek site reached a 3 bar tension after 55 days. The Whiteman Creek site in 1986 reached a 3 bar tension after 30 days. It is apparent to in most years that soil moisture is not limiting to the seedlings before physiological adaptation occures.

The surface soil temperature for the sites is graphed together and appears on pages 11 and 12. The 3 and 12 inch temperature data is available but is not shown here. Levitt (1972) stated that,"injury was induced in the 113 - 140 degrees F range. And that at temperatures above 140 degrees F injury occured because of the breakdown of proteins."(2) "Lorenz (1939) found that the cortical parenchyma cells of several species of angiosperms and gymnosperms were killed within 30 minutes when exposed to temperatures between 135 - 138 degrees F."(2)

The graph of the Whiteman Creek surface temperatures shows that each time the a measurement was taken in the clearcut station, the readings were in the injury or death zone. The reading at the Ophir Creek clearcut station reflect almost the same type of situation. This information brings me to the conclusion that in most years surface temperature is the cause of seedling death, not moisture stress. This is assuming standard planting procedures are followed. It should be noted also that the shade cards provided a 20 - 40 degrees F buffer.

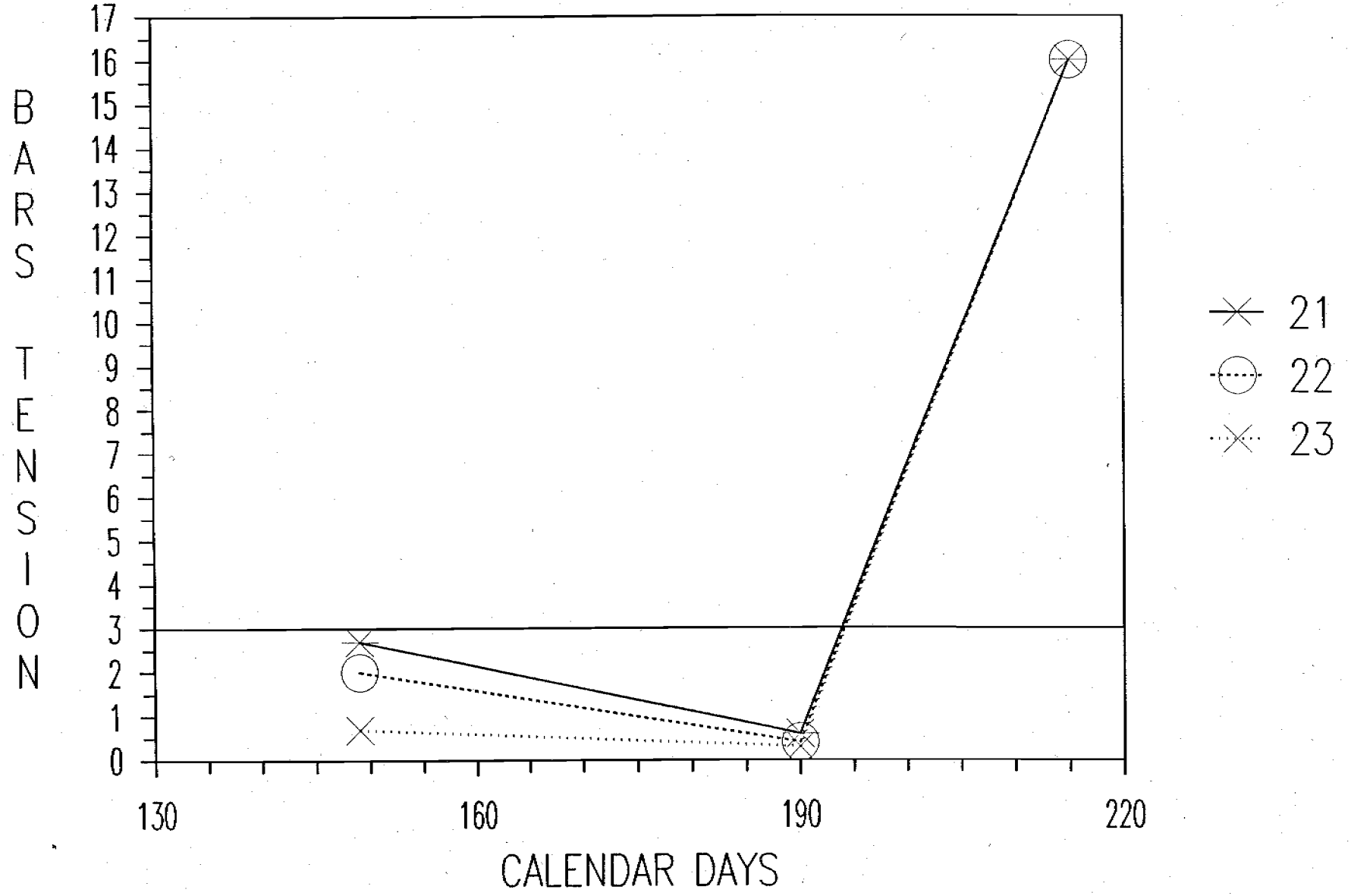
There are 3 points to that can made with this information: (1) The added cost of "microsite planting" and on some areas shade cards may be a very economical management tool. (2) The need to leave adequate material on cutting units during slash disposal cannot be over emphasized, especially on warm aspects. (3) I feel there is a need in our area to look at the amount of overstory canopy left during shelterwood harvests; so that enough canopy is left to keep surface temperatures below the injury zone.

Footnotes: (1) Stuart Childs, Water Relations of Newly PLanted Douglas-Fir Seedlings, 1980, Washington State University.
(2) Kramer and Kozlowski, Physiology of Woodly Plants, 1979, Academic Press.

Dean Sirucek
Soil Scientist

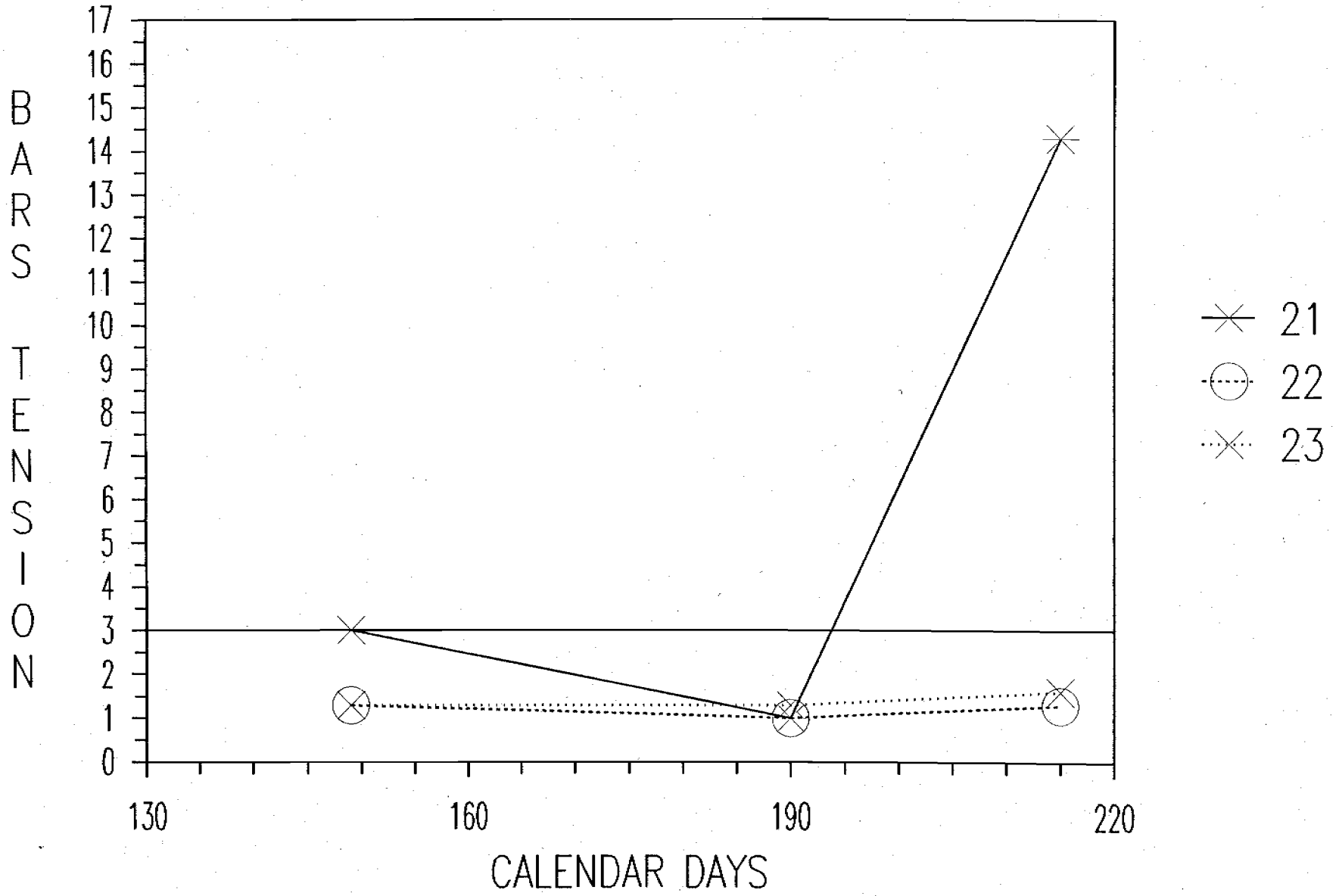
6 INCH SOIL MOISTURE OPHIR CK.YR 1984

SITE #21-CLEARCUT #22-SHADECARDS #23-NATURAL



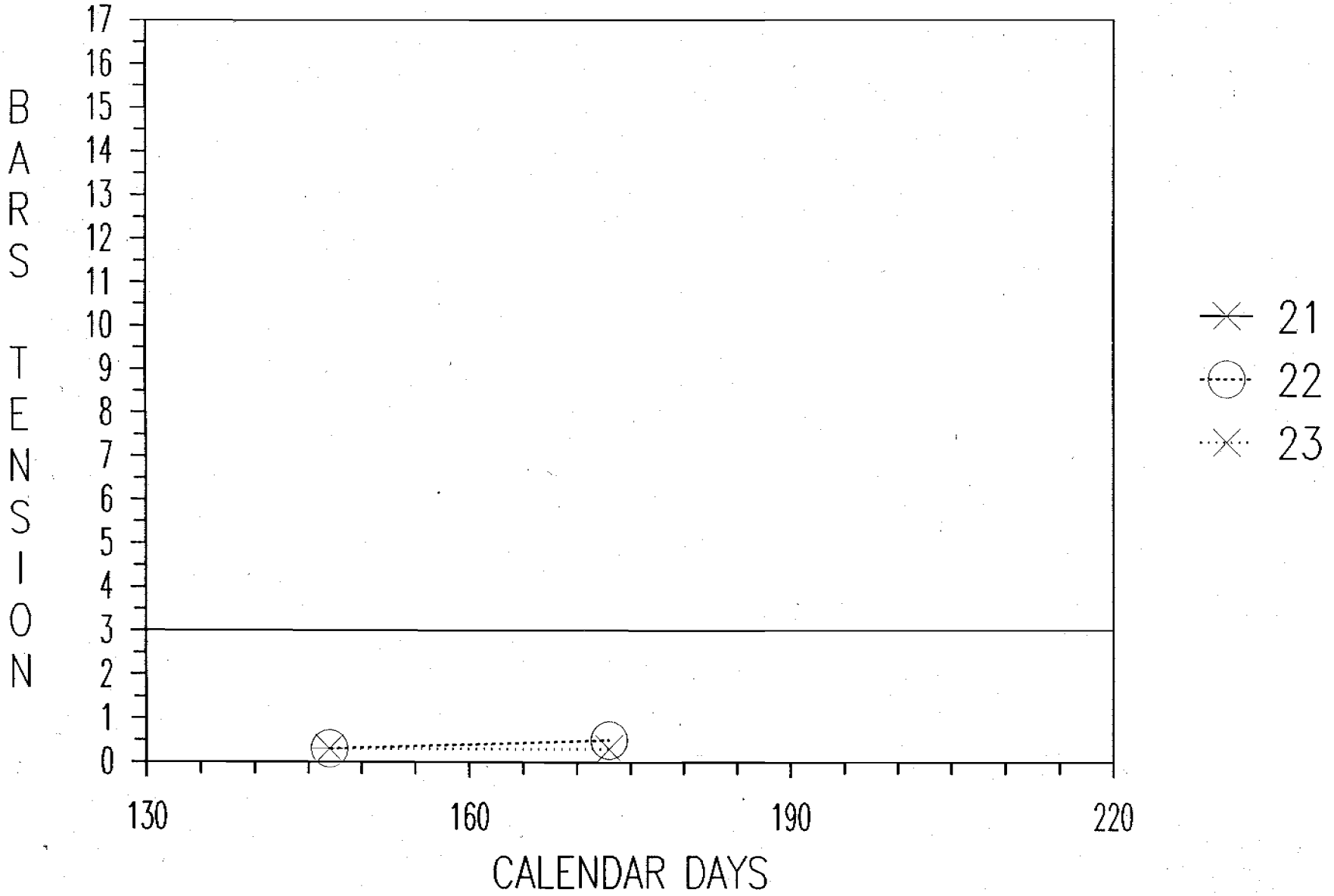
12 INCH SOIL MOISTURE OPHIR CK.YR 1984

SITE #21–CLEARCUT #22–SHADECARDS #23–NATURAL



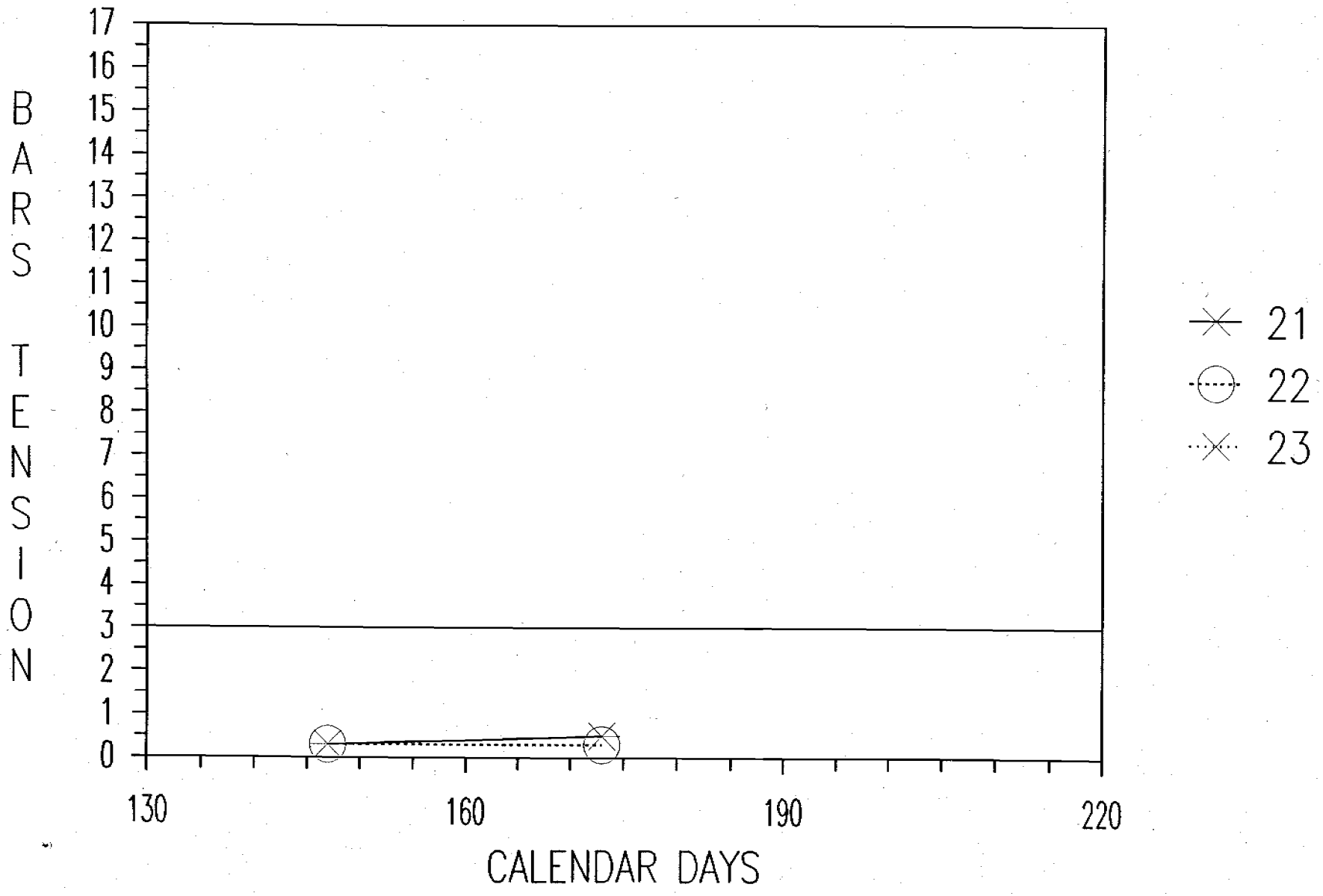
6 INCH SOIL MOISTURE OPHIR CK.YR 1986

SITE #21–CLEARCUT #22–SHADECARDS #23–NATURAL



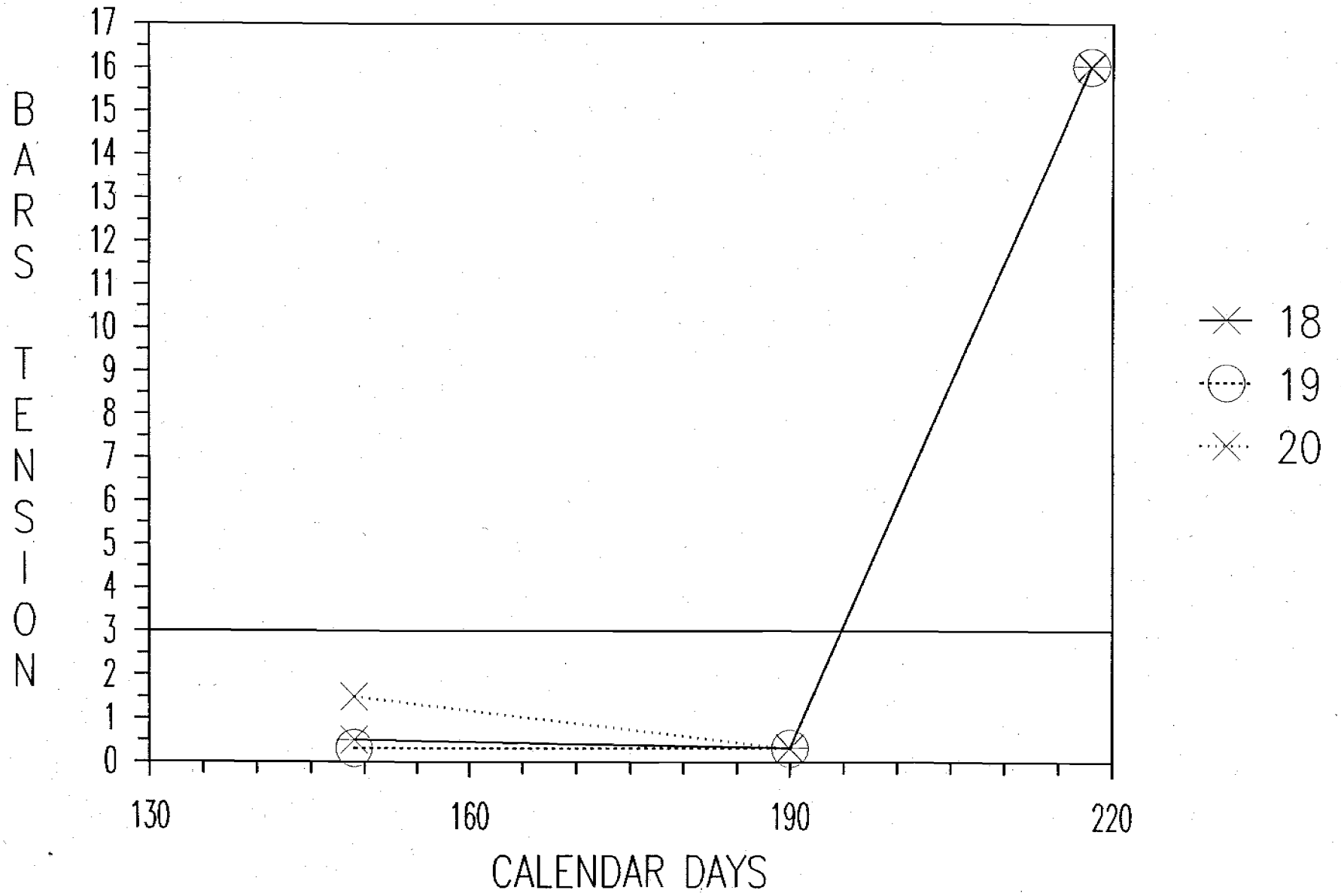
12 INCH SOIL MOISTURE OPHIR CK.YR 1986

SITE #21-CLEARCUT #22-SHADECARDS #23-NATURAL



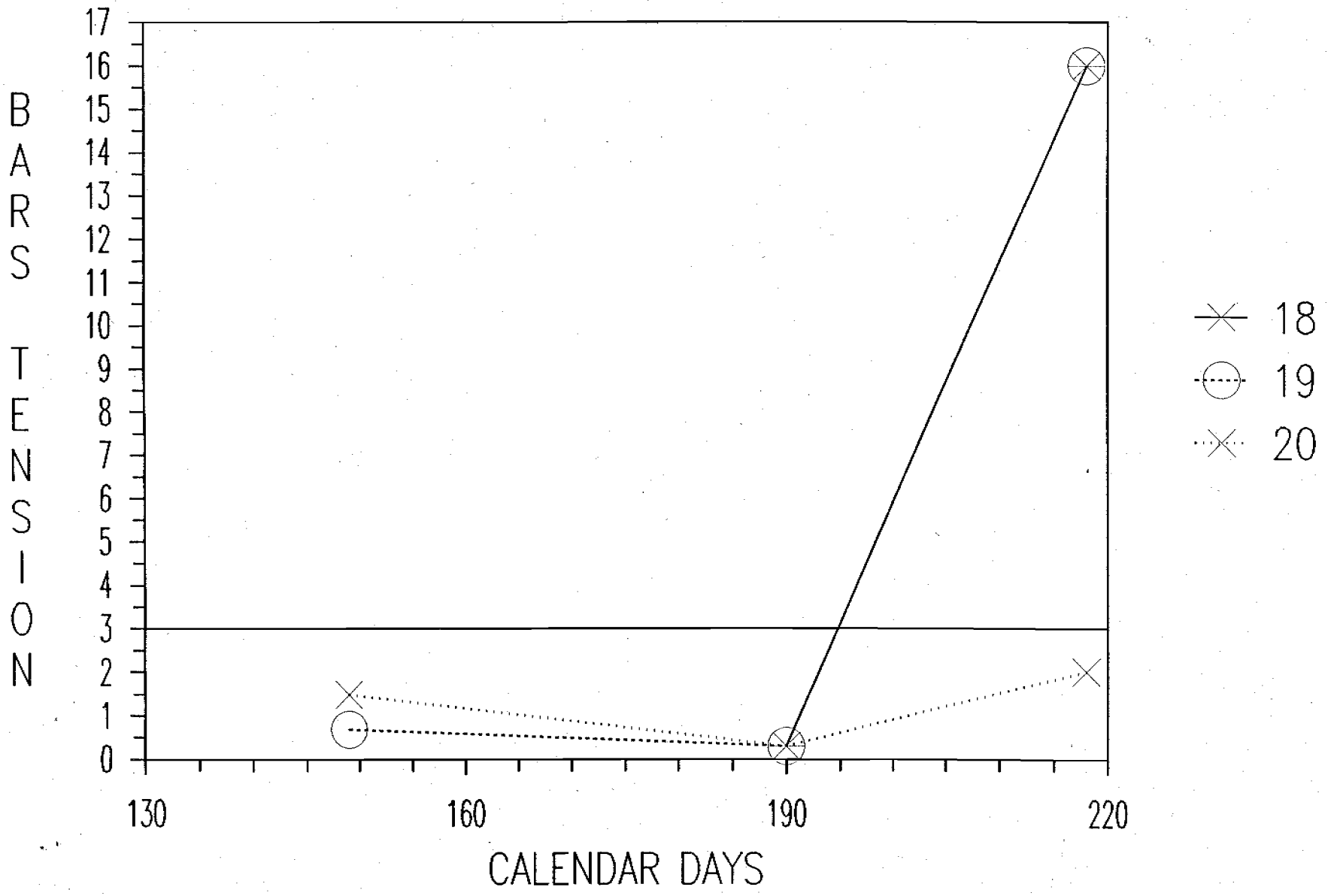
6 INCH SOIL MOISTURE WHITEMAN CK.YR 1984

SITE #18–CLEARCUT #19–SHADECARDS #20–NATURAL



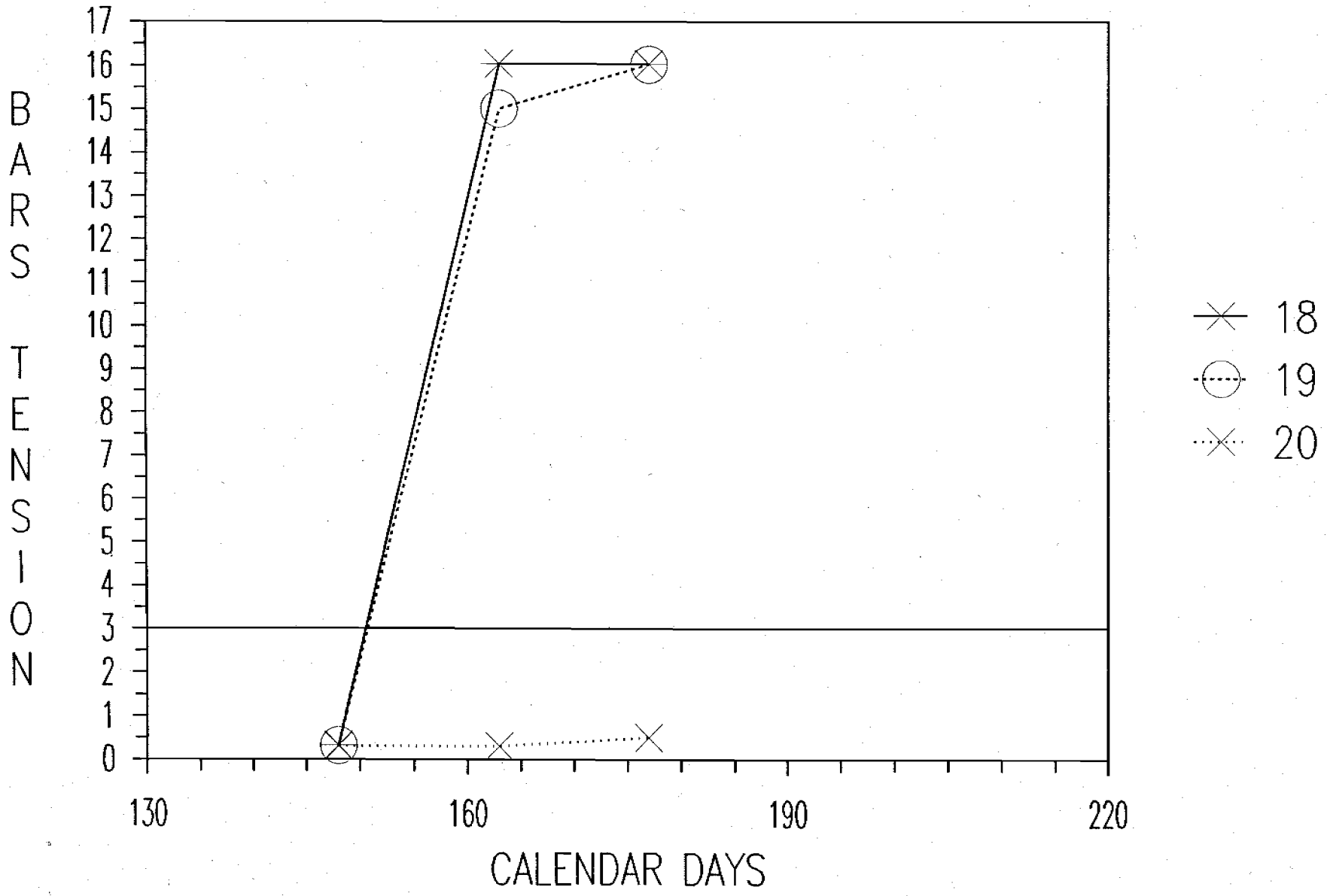
12 INCH SOIL MOISTURE WHITEMAN CK.YR 1984

SITE #18–CLEARCUT #19–SHADECARDS #20–NATURAL



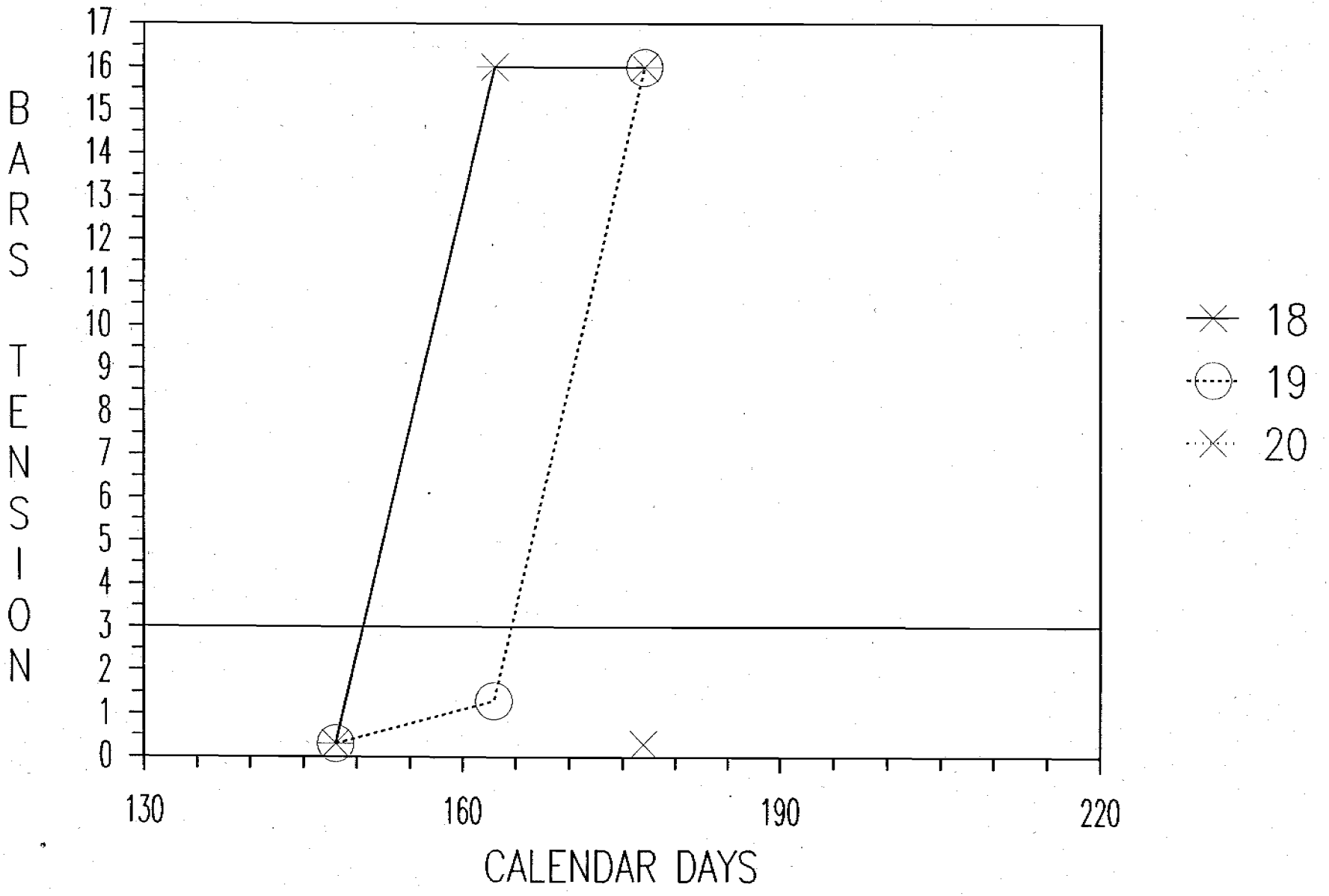
6 INCH SOIL MOISTURE WHITEMAN CK.YR 1986

SITE #18–CLEARCUT #19–SHADECARDS #20–NATURAL



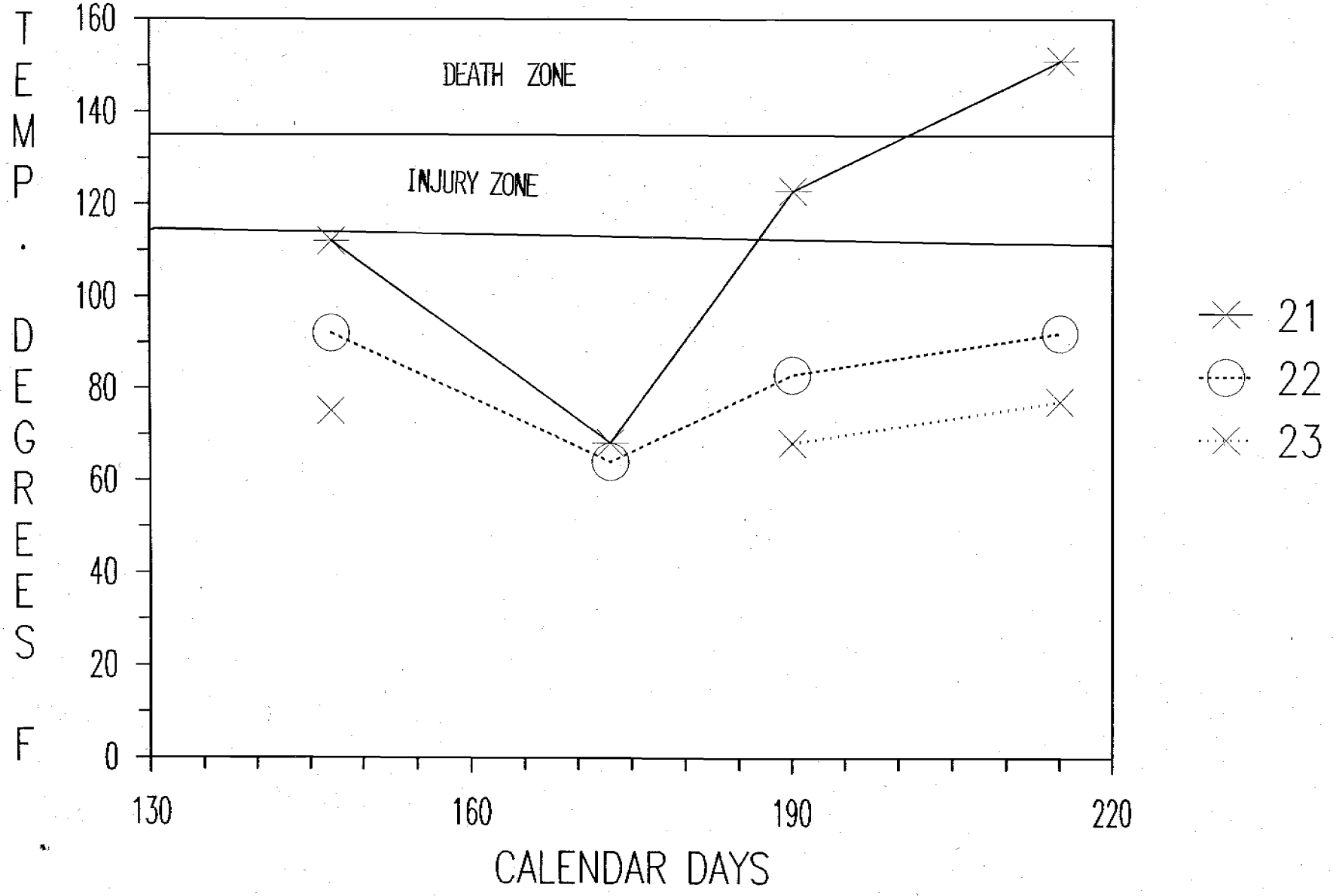
12 INCH SOIL MOISTURE WHITEMAN CK.YR 1986

SITE #18–CLEARCUT #19–SHADECARDS #20–NATURAL



SURFACE TEMP. OPHIR CK. YRS. 1984 & 1986

SITE #21-CLEARCUT #22-SHADECARDS #23-NATURAL



SURFACE TEMP. WHITEMAN CK. YRS. 1984 & 1986

SITE #18–CLEARCUT #19–SHADECARDS #20–NATURAL