STUDIES OF SOME FACTORS AFFECTING SUGAR CANE FLOWERING IN A. R. E.

By

MOHAMED REFAAT MOHAMED BARAKAT

B.Sc. Cairo Univ., 1958

M.Sc. Assiut Univ., 1966

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Name : MOHAMED REFAAT MOHAMED BARAKAT

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Approved by :

M. Abdallah Hussein

A. A. Nassar

M. H. Mousa

Committee in Charge

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INTRODUCTION

Sugar cane crop is one of the most important field crops in A.R.E. Its annual acreage amounted to about 180,000 feddans in 1973/1974 growing season.

The productivity of sugar cane varieties decreases by its growing from one year to another. This necessitates breeding for new highly producing varieties and for keeping the variety productivity high as long as possible. Most sugar cane varieties remain giving high yield for about 10 to 15 years. Then farmers are faced with yield and quality deterioration.

To breed for new varieties, plants have to flower. In Egypt, sugar cane varieties usually do not come into flower.

This work was designed to investigate the effect of light regime, shading and cycocel on flower induction and pollen grains fertility of some cane cultivars. In addition, the seasonal changes in the stem top hormones especially during the critical flowering period was given due consideration.

REVIEW OF LITERATURE

Sugar Cane Flowering :

Flowering of sugar cane plants, or its change from the vegetative growth to the reproductive one, is not a single phenomenon, but it is a chain of different physiological processes separated into the following four major stages by Lang (1952) and Paliatseas, et al., (1956).

1- Floral initiation.
2- Floral organization.
3- Floral maturation.
4- Emergence.

The conditions which determine these different stages are not the same. Dutt et al., (1938) reported that the change from the ordinary vegetative growth to the reproductive phase in the meristemic region of the stem actually begins from 2 to 3 months before the arrow emerges through the spindle. The period between initiation and arrow emergence depends on the variety and the climatic conditions. He pointed out also that emergence of arrow needs about 8 - 11 days.

The description of each flowering stage can be summarized in the following :

1- Initiation :

According to Gardner et al., (1953) floral initiation is the morphological transformation of an induced growing point from a vegetative to floral primordium resulting from the fulfilment of certain thermo-photoperiodic requirements. Van Der Veen et al., (1959) pointed out that as soon as flower initiation has taken place, the growing point becomes flatter and wider and this being modified to the smooth appearance as the primordia of the individual flower become visible.

2- Floral development :

The floral organization and floral maturation are not easily recognized by the naked eye in the sugar cane plant, so Burr et al., (1957); Menchawi (1967) and Bayoumi (1967), combined the two stages into floral development.

Burr et al., (1957) stated that following floral initiation which occurs at the terminal bud, there will be a marked shift in the growth of the young leaves immediately below the flowering bud. Sheaths grow longer while blades were shorter, and the combined length remains nearly constant. At last there will be a blade of only a few inches long on a top of a sheath several feet long. This

what so called "flag stage predicts early emergence of the tassel.

5- Emergence :

Vigayasaradhy et al., (1954) described this stage of flowering that with the progress in growth of the inflorescence there is a steady and progressive increase in the size of the sheaths starting from the fourth upward until it reaches the short blade stage. The panicle and sheaths grow together, while the fourth internode elongate. A progressive increase in the length of the top internodes leading to emergence. So the emergence is a function of the stalk elongation.

Factors Affecting Sugar Cane Flowering

Sugar cane plants flower naturally under tropical and subtropical areas. In other areas, the plants do not flower at all, although one or more stage of flowering may occur but flowering of some sugar cane varieties is arrested due to unfavourable internal or external conditions as was found in Egypt by Arceneaux and Kassem (1963), Bayoumi (1967) and Minchawi (1967).

Vigayasaradhy and Narasimhen (1954) recognized the different stages of inflorescence and concluded that both early, and late flowering varieties initiate primordia at the same time. This finding was confirmed by Burr et al., and Coleman (1959) who claimed that the time of tassel emergence bears little or no relation to the time of flower initiation. By this reasoning, the variety, along with a multitude of environmental and cultural factors, would determine the date of tassel emergence.

On the contrary, Chu and Serapion (1971) at Gurabo, Puerto Rico studied the time of floral initiation and tassel emergence in 78 cane varieties. They concluded that flower primordia are definitely not formed on the same date. They found that the earliest and the latest dates of floral induction were September 3 to 5 and October 1 to 6, respectively. Thus, the time of floral initiation extended over a period of about one month. It was also found that the date of floral initiation was quite constant from year to year.

Factors affecting sugar cane flowering were extensively studied. Some of these factors which were reported to change the life cycle of plant from the vegetative to the reproductive phase are the climatic conditions or the environmental factors such as light, temperature, ... etc.

Brett (1950), Burr (1950 and 1969), Vigayasaradhi et al. (1954 and 1957), Chilton and Paliatseas (1956), Paliatseas (1956 and 1963), Coleman (1959, 1962, 1963 and 1969), Arceneaux and Kassem (1963), Van Breemer et al., (1963), Clements et al., (1964), James and Smith (1969), Julien (1968, 1969 and 1970), Amine et al., (1972) and others.

In addition to the climatic factors the internal or physiological factors such as plant age as well as the nature of the flowering stimulus in the plant, ... etc, received the attention of many investigators. Mazik and La Rue (1952), Bonner and Liverman (1953), Sonay (1953), Burr et al. (1957), Coleman (1959 and 1969), George (1960), Clements and Awada (1962), Audus (1963), Evans (1964), Alleweldt (1968), Mallette et al. (1968), Roa et al. (1969), Julien (1969), Alexander et al. (1972) and Alexander (1973) and others.

I. Flowering in Response to Light :

Salisbury (1966), reported that the three light components; quality (colour or wave length), intensity and duration, vary more or less continuously in nature and all are important to the photoperiodism aspect of the flowering process.

The effect of light on sugar cane flowering received a great deal of work by several investigators. Alexander (1973) gave a good review of these studies.

1- Light quality in nature :

Salisbury (1966), indicated that perhaps the quality of light varies the least in nature. Curtis et al., (1950) illustrated the quality of sunlight, showing that light intensity (relative energy) of the visible light at any given wave length during the day represent about half of the solar spectrum. Nearly the other half, however, consists of longer wave lengths.

They noted also that the peak of midday curve falls approximately in the region of green light. Most plant processes are relatively insensitive to light of these wave length. The changes in light quality in nature usually considered to be minor important. The amount of moisture or minute particles in air such as smoke or smog may have a direct effect on light quality. Ultra-violet light is absorbed by the atmosphere and consequently as one goes higher in elevation above sea level, a slight higher proportion of ultra-violet light is encountered. On the contrary red wave lengths penetrate the atmospheric

constituents more readily than the shorter wave lengths. Thus when the sun is very low on the horizon (in the morning or in the evening), its rays must penetrate a much thicker layer of atmosphere, and those reaching the earth may be predominantly red.

They added that light quality also changes slightly throughout the year at temperate latitudes since the rays must pass through more in winter when the sun appears lower in the sky.

The same results of the total solar radiation intensity and their relation to day light intensity was recorded by Kimball (1924).

2- Light duration or photoperiod :

By 1920 the classic studies of Garner and Allard had shown that numerous plants bear a special sensitivity to light and produce flowers only in response to specific day or night length. Among the factors which influence flowering in sugar cane are the photoperiodic requirements for floral induction which have been examined more than any other.

Chilton and Paliatseas (1956) concluded that sugar cane flowering is a photoperiodic response and can be induced in sugar cane by gradually shortening the day length.

However, because sugar cane possesses an extremely narrow range of suitable day and night length for flower production, it has been difficult to classify this plant on a photoperiodic basis, Alexander (1973). Thus various workers have classified the Saccharum species as short day plant Burr (1950), and Vijayasaradhy et al. (1957-a), (1957-b) or as intermediate day plant Sartoris(1938), Paliatseas(1954),Clements et al. (1962 and 1964) and Clements (1968), and as long-short day plant, Sachs (1956).

Burr (1950), described sugar cane as a short-day plant after observing flower inhibition by dark period interruption. Short day plants require a long uninterrupted dark period in order to flower.

Vijayasaradhy et al., (1954, 1957-a and 1957-b), in India succeeded in forcing any cane they worked with into flower by extending the natural night by 2 to 4 hours. The reluctant ones were forced into blossom by the prior light treatment extension by 4 hours, then they were transferred