NUTRIENT UPTAKE OF COTTON AT VARIOUS PHYSIOLOGICAL STAGES

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Abstract

There have been various studies that have correlated the nutrient uptake of cotton with the growth stages of cotton. A review of much of this data can be found in reviews by (Mullins and Burmester, 2010) and (Rochester, Constable, Oosterhuis and Errington 2012).

Cotton is an interesting plant in that as a perennial plant, it has an indeterminate growth pattern. It seeks to survive to the next growing season. Shedding of fruiting forms under stress conditions and adding new vegetative growth and fruiting positions under better growing conditions is normal. This may have good or bad effects on cotton yields depending largely on when in the growing season this stress occurs. Research by Mullins and Burmester (1991) in a non-irrigated test revealed that four cotton varieties with wide differences in maturity and growth characteristics still partitioned dry matter similarly at the same location. These same varieties at a different location with less rainfall, however, partitioned a larger percentage of dry matter into lint. Final yields were similar at both sites which indicate cotton's ability to adapt to less than ideal growing conditions and still produce acceptable yields.

Cotton growth and dry matter production normally follows a sigmoidal curve (Oosterhuis, 1990) with a rapid increase in production occurring after flowering (Fig. 1). Research has also shown that nutrient uptake of the major nutrients follows a very similar pattern (Figs. 2, 3, 4). At early bloom, the cotton plant's peak daily uptake of

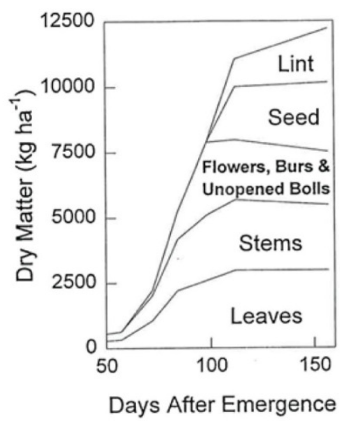

Figure 1. Dry matter production by irrigated cotton (Halevy, 1976).

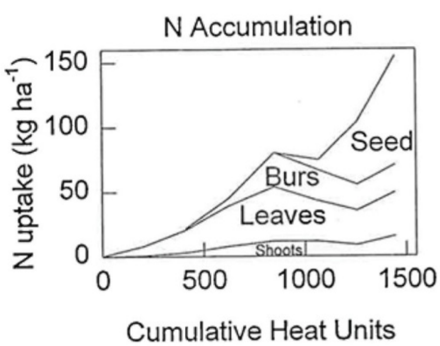

Figure 2. Uptake and partitioning of nitrogen by non-irrigated cotton (Mullins and Burmester, 1991).

nitrogen, phosphorous and potassium occurs. (Fig.5). Nitrogen is the plant nutrient cotton removes from the soil in the largest amount, with the largest percentage partitioned into the seed (Fig. 2). Potassium is also taken up in large amounts with the largest percent being partitioned in to the burs but a significant amount also being taken up in the lint (Fig. 2). Phosphorus is taken up in much smaller amounts (Figure 3) with a majority of phosphorus partitioned

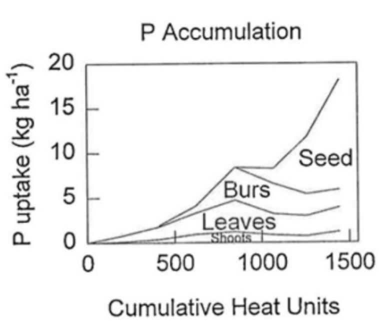

Figure 3. Uptake and partitioning of phosphorous by non-irrigated cotton (Mullins and Burmester, 1991).

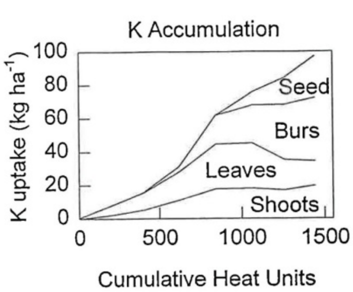

Figure 4. Uptake and partitioning of potassium by non-irrigated cotton (Mullins and Burmester, 1991).

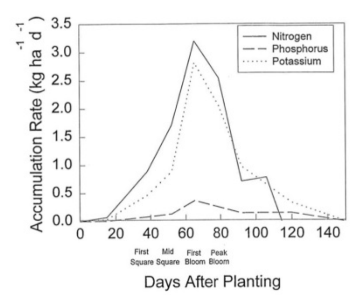

Figure 5. Average daily uptake rates for N, P, and K by non-irrigated cotton (Mullins and Burmester, 1991).

into the seed. After peak bloom, daily uptake rates of these three nutrients decrease greatly (Fig 5). Research by Taylor and Klepper, (1974) indicated a cotton plant's root mass increases up to the point when young bolls are formed. Research by Hons and McMichael (1986) also found that old cotton roots began dying about early bloom. New roots were formed, but at a slower rate, resulting in a decline of total root growth. This indicates the importance of adequate nutrient uptake by cotton plants before early bloom to satisfy the redistribution of nutrients to young bolls and the production of dry matter growth for the remaining season.

Modern cotton varieties (breeding1950-present) have been shown to partition more of dry matter growth into bolls than earlier varieties (Wells and Meredith, 2012). They also showed that cotton yields in the United States have been increasing by an average of 13.5 lb/acre since the year 2000. These yield increases may be due in part to breeding of varieties with smaller bolls, but with larger lint percentages. Other factors such as large increases in irrigation cotton acreage, boll weevil eradication, development of Bt and herbicide resistant varieties, may all be factors in reducing cotton stress through the season and increasing cotton yields in the United States.

Higher cotton yields mean better management of crop nutrients through the growing season will be needed. Data from Rochester (2007) with irrigated cotton in Australia found nitrogen, phosphorus, and potassium removal rates of 42, 11 and 16 kg/ha respectively with yields of 1000 kg/ha. When yields increased to 1800 kg/ha the removal values increased to 91, 16 and 28 kg/ha respectively. Leaf and petiole analysis have been used widely in cotton management and values may need adjustment as cotton's yield goals rise.

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