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# Maturity of Cotton Cultivars in Multan as Determined by Nodes above White Flower

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**Abstracts:** The node above white flower (NAWF) technique was used to monitor the growth, development and maturity of ten cotton varieties viz. Reshmi, CIM-443, MNH-93, MNH-329, MNH-395, MNH-439, S-12, FH-900, CIM-1100 and NIAB-78 during the years 1997, 1998 and 1999. The NAWF counts were made at weekly intervals. By regressing NAWF means over time, the number of days to reach NAWF of 5.0 (NAWF-5) was determined. Days to NAWF-5 were highly correlated with percent first pick of seed cotton yield. It was observed that NIAB-78 and CIM-443 achieved NAWF-5 earlier by 109.86 and 109.09 days (average of three years). Days to NAWF-5 provided a focal point for all management decisions. Therefore, it became evident that NAWF technique could be used for monitoring cotton plant after flowering, earliness determination of variety/strain and detecting fruiting problems during growth season.

**Key words:** Nodes, white flower, Maturity, cotton

## Introduction

Cotton is the most important textile fiber crop and second most important oil seed crop in the world (Chary and Leffler, 1984). It is also one of the most important cash crops of Pakistan which accounts for 60% of total foreign exchange earnings through export of lint and value added cotton products. It provides raw material to domestic cotton industry comprising 503 textile mills, 1139 ginning factories and over 5000 oil expelling units (Mahmood, 1999). It has 85% share in total vegetable oil produced in the country. Cottonseed cake, an important by-product of cotton, is a valuable source of protein for ruminant cattle. In addition, 40% labour force of the country is employed in cotton fields and cotton processing mills (Mahmood, 1999). Keeping in view the above facts, cotton is rightly described as the backbone of Pakistan economy.

Early maturity in cotton has many advantages. It enables the cotton crop to develop during periods of more favourable environmental conditions and to be picked before damage from unfavourable weather. Moreover, early maturity helps to fit the crop into double cropping pattern as in cotton growing area of Pakistan, wheat is followed after cotton. Early maturity, therefore, is an important component of cotton production in Pakistan farming system. Several methods have been used to produce an early cotton crop, such as chemical termination, early irrigation cut off, early defoliation, genetically induced earliness or the combination of all or some of these methods (Neil, 1991). Genetically induced earliness is determined by many plant characters including the days taken from sowing to square formation, number of days taken for flower development and the time required from the boll formation to maturity. The relative length of these periods varies in different varieties, moreover, environmental conditions in which the cotton plant is grown affect these periods. To develop early maturing cotton, concentration should be focussed on reduction of the periods of above-mentioned factors by changing the genetic constitution of the plant.

Bourland *et al.* (1992) studied maturity in cotton cultivars in Arkansas as determined by nodes above white flower. Accurate description of maturity of cotton cultivars was needed for choosing cultivars performance Node above white flower (NAWF) during the growing season described the progress of fruit accumulation relative to vegetative potential. They recorded the counts of NAWF at nearly week intervals in four tests for two years. By regressing means counts of NAWF over time, number of days to reach NAWF of 5.0 (NAWF-5) was determined. Thus they observed that the days to NAWF-5 stage was highly correlated with percent first pick. Differences among cultivars for potential maturity could be detected during early flowering season using the NAWF index. Days to NAWF-5 provided a precise and easy method/measure to use for description of relative maturity of cotton cultivars.

**Material and Methods**

The present investigations to determine the maturity of cotton varieties were carried out in the experimental area of Cotton Research Station, Multan during the years 1996, 1997 and 1998. The genetic material comprised the ten varieties of upland cotton (*G. hirsutum* L.) viz. Reshmi, CIM-443, NIAB-78, S-12, FH-900, MNH-395, MNH-439, MNH-329, MNH-93 and CIM1100.

Ten varieties were sown in field during month of June 1997, May 1998 and May 1999. The design of the experiment was randomized complete block with three replications. The sowing was done by dibbling three seeds per hill to ensure uniform stand, later thinned to one plant per hill. Each experimental plot was comprised of three rows of 3.3 m long and with 30 cm plant to plant distance. The row to row distance was kept 75 cm and the data was collected from 10 guarded plants of central row. Data regarding NAWF (nodes above white flower) were recorded at weekly interval, after two weeks of flower initiation. Daily flowers count on per plant basis was recorded and converted into number of flowers per week. The flowers converted into bolls were also recorded on weekly basis to compute boll retention on weekly basis for two years i.e. 1997 and 1998.

Daily boll opening was also counted on single plant basis and then boll retention on week basis was computed. First pick was harvested after 140 days from planting on individual plant basis and percent first pick was calculated. Second pick was harvested, when all mature bolls were opened and seed cotton was collected in paper bags separately for all the plants in all the three replications. The seed cotton was weighed by electric balance.

Finally the average yield of seed cotton per plant in grams was calculated by summing the first and second pick. Mean for the sequential dates were regressed on days from planting. Using these regression equations, numbers of days required to attain NAWF of 5.0 (NAWF-5) were calculated. Simple correlation coefficients among days to NAWF-5, percent first pick and seed cotton yield was then determined by using the method given by Gomez and Gomez (1983).

**Results and Discussion**

The data recorded for NAWF for all the ten varieties under study for consecutive three years 1997, 1998 and 1999 revealed that the value of NAWF was near seven or above during early flowering season and this value existed for four to five weeks, then declined as flowering period continued (Table 1,2,3). This decrease in NAWF value indicated that more assimilate was diverted to develop bolls, less was available for further vegetative growth, which confirms the earlier findings of Cappy (1979) Oosterhuis *et al.* (1989) and Bourland *et al.* (1991), who reported that as fruit developed more photosynthate was diverted to the developing bolls and less was available for continued vegetative growth. The decrease in NAWF value may thus provided an indication of source-sink growth activity of the crop with reference to the development of bolls and vegetative growth of the main stem. This study also suggested that the decline in NAWF provides an indication that the sink associated with developing bolls has become sufficiently strong, relative to vegetative growth, to slow down further main stem growth and abort or impede the production and development of additional bolls.

NAWF value of seven or more indicated a maximum amount of photosynthate available for developing bolls and this value should exist for four to five weeks under favourable cotton growing conditions. Crop monitoring, especially in the first four to five weeks of flowering, becomes a critical adjunct to the use of NAWF. It can further be safely concluded that any production practice that extends the effective flowering period would increase cotton yield, if external factors such as insects and diseases remain under control and favourable weather conditions prevail during the season.

It was further observed (Table 1, 2, 3) that the critical value for NAWF-5 reached during the sixth and seventh week of flowering in all varieties during all the three years of study. However, during 1997 the lowest values of NAWF 3.3, 3.4 were recorded on 26.09.97 for the varieties FH-900, NIAB-78, MNH439 and S-12, respectively. During 1998 lowest NAWF values 3.5 and 3.8 were recorded on 15th Sept., 1998 for the varieties NIAB-78 and CIM-443, respectively. Similarly during 1999, the NAWF value 3.9 and 4.2 were obtained on 20th Sept. 1999 for varieties NIAB-78 and CIM-443, respectively. It showed that NIAB-78 and CIM-443 accumulated fruit more fastly and matured earlier than other varieties which is also evident from percent first pick (Table 1,2,3). The highest values of 38.0 and 36.0% first pick (Table 1,2,3) was obtained from CIM-443 and NIAB-78, respectively during the year 1997. While during the year 1998 the values of percent first pick 39.0 and 36.0 were obtained from NIAB-78 and CIM-443, respectively which were the highest of all other varieties. Similarly, 39.0 and 34.0 values of percent first pick were obtained for NIAB-78 and CIM-443 during 1999.

On the basis of three years data, the average number of days taken after planting (DAP) to achieve the NAWF-5 stage were computed for all varieties (Table 11), the data revealed that CIM-443 and NIAB-78 were earliest and required 109 and 109.9 DAP, respectively to attain

Table 1: Number of nodes above white flower (NAWF) for varieties under study during 1997

| | NAWF by date | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Cultivars | 4/8 | 11/8 | 19/8 | 26/8 | 2/9 | 10/9 | 17/9 | 26/9 | % 1st pick |
| Reshmi | 7.2 | 7.7 | 7.9 | 8.8 | 7.9 | 7.0 | 6.2 | 4.0 | 21.3 |
| CIM-443 | 6.9 | 7.5 | 7.8 | 7.8 | 7.6 | 7.2 | 5.2 | 4.4 | 38.0 |
| N-78 | 6.5 | 6.6 | 6.8 | 8.2 | 7.4 | 7.3 | 4.5 | 3.4 | 36.0 |
| S-12 | 7.2 | 7.7 | 8.1 | 8.0 | 7.4 | 6.4 | 5.5 | 3.4 | 29.0 |
| FH-900 | 6.8 | 7.2 | 7.6 | 8.7 | 7.7 | 7.3 | 5.9 | 3.3 | 28.8 |
| CIM-1100 | 7.8 | 9.0 | 9.1 | 8.2 | 8.7 | 7.8 | 6.3 | 5.4 | 19.0 |
| MNH-439 | 7.1 | 6.4 | 6.8 | 8.1 | 7.9 | 6.9 | 5.2 | 3.4 | 29.7 |
| MNH-395 | 7.0 | 7.5 | 7.7 | 8.5 | 8.1 | 7.4 | 6.5 | 4.4 | 18.0 |
| MNH-329 | 7.7 | 8.1 | 8.5 | 8.2 | 8.8 | 7.1 | 6.8 | 4.6 | 18.2 |
| MNH-93 | 6.2 | 6.5 | 6.6 | 8.3 | 7.9 | 7.2 | 5.1 | 4.4 | 21.5 |
| LSD 0.05 | 0.409 | 0.355 | 0.338 | 0.248 | 0.230 | 0.121 | 0.153 | 0.143 | |

Date of sowing = 18/6/97

Table 2: Number of nodes above white flower (NAWF) for varieties under study during 1998

| | NAWF by date | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Cultivars | 27/7 | 4/8 | 11/8 | 18/8 | 25/8 | 1/9 | 8/9 | 15/9 | % 1st pick |
| Reshmi | 9.0 | 7.0 | 7.5 | 6.3 | 5.8 | 5.4 | 5.2 | 4.1 | 22.0 |
| CIM-443 | 8.0 | 8.0 | 7.1 | 6.3 | 5.2 | 5.1 | 4.2 | 3.8 | 36.0 |
| N-78 | 8.5 | 8.4 | 7.0 | 6.5 | 5.9 | 4.9 | 4.1 | 3.5 | 39.0 |
| S-12 | 11.3 | 11.5 | 11.5 | 7.5 | 5.8 | 5.1 | 5.0 | 4.5 | 32.0 |
| FH-900 | 9.8 | 9.5 | 8.4 | 7.1 | 6.2 | 5.5 | 4.9 | 4.2 | 28.0 |
| CIM-1100 | 9.5 | 8.5 | 8.1 | 7.3 | 6.5 | 5.8 | 5.3 | 5.0 | 16.0 |
| MNH-439 | 9.1 | 8.5 | 8.5 | 7.6 | 6.2 | 5.3 | 4.9 | 4.8 | 19.0 |
| MNH-395 | 10.2 | 9.5 | 8.1 | 7.8 | 6.5 | 5.9 | 5.2 | 4.9 | 18.0 |
| MNH-329 | 9.5 | 10.1 | 8.9 | 8.2 | 7.1 | 6.2 | 5.1 | 4.8 | 15.0 |
| MNH-93 | 8.9 | 8.2 | 7.6 | 6.9 | 6.7 | 6.0 | 5.3 | 4.4 | 23.0 |
| LSD 0.05 | 0.334 | 0.307 | 0.363 | 0.537 | 0.453 | 0.364 | 0.076 | 0.094 | |

Date of sowing = 15/5/98

Table 3: Number of nodes above white flower (NAWF) for varieties under study during 1999

| | NAWF by date | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Cultivars | 1/8 | 8/8 | 15/8 | 22/8 | 29/8 | 6/9 | 13/9 | 20/9 | % 1st pick |
| Reshmi | 10.5 | 10.2 | 9.5 | 8.8 | 8.1 | 6.5 | 5.3 | 4.7 | 21.0 |
| CIM-443 | 9.7 | 9.8 | 9.1 | 8.5 | 8.4 | 5.4 | 4.9 | 4.2 | 34.0 |
| N-78 | 10.1 | 9.5 | 9.4 | 8.7 | 8.2 | 6.1 | 4.8 | 3.9 | 39.0 |
| S-12 | 9.4 | 9.1 | 9.3 | 8.9 | 7.5 | 6.3 | 5.1 | 4.5 | 31.0 |
| FH-900 | 9.5 | 9.0 | 8.5 | 8.1 | 7.6 | 6.5 | 5.3 | 4.7 | 28.0 |
| CIM-1100 | 11.5 | 10.5 | 9.3 | 8.7 | 7.5 | 6.8 | 5.8 | 4.9 | 18.0 |
| MNH-439 | 10.1 | 9.9 | 9.5 | 9.1 | 8.1 | 6.5 | 5.6 | 4.7 | 15.0 |
| MNH395 | 9.8 | 10.5 | 9.5 | 8.9 | 7.2 | 6.4 | 5.5 | 4.8 | 19.0 |
| MNH-329 | 10.5 | 9.6 | 9.5 | 8.5 | 7.6 | 7.1 | 6.2 | 4.9 | 25.0 |
| MNH-93 | 9.7 | 10.2 | 9.5 | 8.1 | 6.9 | 5.8 | 5.1 | 4.5 | 27.0 |
| LSD 0.05 | 0.242 | 0.248 | 0.210 | 0.271 | 0.254 | 0.297 | 0.094 | 0.121 | |

Date of sowing = 25/5/99

Table 4: Mean squares for number of nodes above white flower during 1997

| SOV | d.f | 4/8/97 | 11/8/97 | 18/8/97 | 26/8/97 | 2/9/97 | 10/9/97 | 17/9/97 | 26/9/97 |
|---|---|---|---|---|---|---|---|---|---|
| Repeats | 2 | 0.058 | 0.025 | 0.032 | 0.001 | 0.010 | 0.011 | 0.012 | 0.009 |
| Varieties | 9 | 0.700** | 1.899** | 1.940** | 0.268** | 0.765** | 0.392** | 1.604** | 1.380** |
| Error | 18 | 0.057 | 0.043 | 0.039 | 0.021 | 0.018 | 0.005 | 0.008 | 0.007 |

*: P ≤ 0.05 ; ** : P ≤ 0.01

Table 5: Mean squares for number of nodes above white flower during 1998

| SOV | d.f | 27/7/98 | 4/8/98 | 11/8/98 | 18/8/98 | 25/8/98 | 1/9/98 | 8/9/98 | 15/9/98 |
|---|---|---|---|---|---|---|---|---|---|
| Repeats | 2 | 0.720 | 0.301** | 0.283* | 0.210 | 0.076 | 0.017 | 0.014 | 0.005 |
| Varieties | 9 | 2.631** | 4.837** | 5.075** | 1.139** | 0.959** | 0.567** | 0.558** | 0.718** |
| Error | 18 | 0.038 | 0.032 | 0.045 | 0.098 | 0.070 | 0.045 | 0.002 | 0.003 |

*: P ≤ 0.05 ; ** : P ≤ 0.01

Table 6: Mean squares for number of nodes above white flower during 1999

| SOV | d.f | 1/8/99 | 8/8/99 | 15/8/99 | 22/8/99 | 29/8/99 | 6/9/99 | 13/9/99 | 20/9/99 |
|---|---|---|---|---|---|---|---|---|---|
| Repeats | 2 | 0.049 | 0.064* | 0.072** | 0.009 | 0.036 | 0.002 | 0.019 | 0.002 |
| Varieties | 9 | 1.205** | 0.854** | 0.320** | 0.338** | 0.715** | 0.699** | 0.525** | 0.365** |
| Error | 18 | 0.020 | 0.021 | 0.015 | 0.025 | 0.022 | 0.030 | 0.003 | 0.005 |

*: P ≤ 0.05 ; ** : P ≤ 0.01

Table 7: Regression equations for number of nodes above white flower (NAWF) by days from planting and calculated number of days to NAWF of 5.0 for cotton varieties during 1997

| | NAWF by days, regression equation | | | |
|---|---|---|---|---|
| Cultivars | A | b | $R^2$ | Days to NAWF-5 |
| Reshmi | 15.92 | -0.10 | 0.97 | 109 |
| CIM-443 | 15.98 | -0.11 | 0.96 | 102 |
| N-78 | 15.38 | -0.09 | 0.99 | 110 |
| S-12 | 14.56 | -0.09 | 0.91 | 106 |
| FH-900 | 15.66 | -0.10 | 0.91 | 106 |
| CIM-1100 | 14.71 | -0.09 | 0.95 | 108 |
| MNH-439 | 13.61 | -0.07 | 0.93 | 110 |
| MNH-395 | 16.05 | -0.11 | 0.97 | 100 |
| MNH-329 | 13.41 | -0.07 | 0.89 | 122 |
| MNH-93 | 14.94 | -0.09 | 0.95 | 112 |

Table 8: Regression equations for number of nodes above white flower (NAWF) by days from planting and calculated number of days to NAWF of 5.0 for cotton varieties during 1998

| | NAWF by days, regression equation | | | |
|---|---|---|---|---|
| Cultivars | A | b | $R^2$ | Days to NAWF-5 |
| Reshmi | 14.20 | -0.08 | 0.92 | 114.0 |
| CIM-443 | 14.52 | -0.09 | 0.96 | 108.0 |
| N-78 | 17.09 | -0.11 | 0.97 | 109.9 |
| S-12 | 21.82 | -0.15 | 0.82 | 112.1 |
| FH-900 | 17.34 | -0.11 | 0.94 | 112.2 |
| CIM-1100 | 14.38 | -0.08 | 0.88 | 117.3 |
| MNH-439 | 16.93 | -0.10 | 0.96 | 115.8 |
| MNH-395 | 17.36 | -0.11 | 0.95 | 117.7 |
| MNH-329 | 16.12 | -0.09 | 0.82 | 123.5 |
| MNH-93 | 18.02 | -0.11 | 0.92 | 116.2 |

Table 9: Regression equations for number of nodes above white flower (NAWF) by days from planting and calculated number of days to NAWF of 5.0 for cotton varieties during 1999

| | NAWF by days, regression equation | | | |
|---|---|---|---|---|
| Cultivars | A | b | $R^2$ | Days to NAWF-5 |
| Reshmi | 19.72 | -0.12 | 0.96 | 115.9 |
| CIM-443 | 19.17 | -0.13 | 0.89 | 109.0 |
| N-78 | 19.75 | -0.13 | 0.92 | 113.5 |
| S-12 | 17.69 | -0.11 | 0.90 | 115.3 |
| FH-900 | 16.61 | -0.10 | 0.95 | 117.3 |
| CIM-1100 | 20.45 | -0.13 | 0.99 | 118.8 |
| MNH-439 | 18.84 | -0.11 | 0.94 | 118.3 |
| MNH-395 | 18.99 | -0.12 | 0.93 | 116.6 |
| MNH-329 | 18.10 | -0.10 | 0.97 | 120.2 |
| MNH-93 | 19.14 | -0.12 | 0.95 | 112.2 |

Table 10: Correlation coefficients among seed cotton yield, percent first pick and days from planting to node above white flower (days to NAWF-5) for varieties

| Variable by years | Correlation coefficient |
|---|---|
| 1997 | |
| Percent first pick vs yield | +0.713** |
| Days to NAWF-5 vs Yield | -0.789** |
| Days to NAWF-5 vs Percent first pick | -0.493** |
| 1998 | |
| Percent first pick vs yield | +0.818** |
| Days to NAWF-5 vs Yield | -0.576** |
| Days to NAWF-5 vs Percent first pick | -0.648** |
| 1999 | |
| Percent first pick vs yield | +0.821** |
| Days to NAWF-5 vs Yield | -0.749** |
| Days to NAWF-5 vs Percent first pick | -0.897** |

*, ** correlation coefficient significantly different from zero at the 0.05 and 0.01 probability levels , respectively

Table 11: Average of three years for days taken to NAWF-5

| Variety | Year | Days taken to NAWF-5 | Maximum deviation from mean | Average deviation |
|---|---|---|---|---|
| Reshmi | 1997 | 109.2 | | |
| | 1998 | 114.0 | | |
| | 1999 | 115.9 | | |
| | Av | 113.03 | 3.83 | 2.55 |
| CIM-443 | 1997 | 110.2 | | |
| | 1998 | 108.0 | | |
| | 1999 | 109.0 | | |
| | Av | 109.09 | 1.20 | 0.78 |
| N-78 | 1997 | 106.2 | | |
| | 1998 | 109.9 | | |
| | 1999 | 113.5 | | |
| | Av | 109.86 | 3.70 | 2.44 |
| S-12 | 1997 | 100.45 | | |
| | 1998 | 112.1 | | |
| | 1999 | 115.3 | | |
| | Av | 109.2 | 8.83 | 5.88 |
| FH-900 | 1997 | 106.6 | | |
| | 1998 | 112.2 | | |
| | 1999 | 117.3 | | |
| | Av | 112.03 | 5.43 | 3.62 |
| CIM-1100 | 1997 | 122.4 | | |
| | 1998 | 117.2 | | |
| | 1999 | 118.8 | | |
| | Av | 119.5 | 2.92 | 1.94 |
| MNH-439 | 1997 | 102.4 | | |
| | 1998 | 115.8 | | |
| | 1999 | 118.3 | | |
| | Av | 112.17 | 9.77 | 6.51 |
| MNH-395 | 1997 | 112.2 | | |
| | 1998 | 117.2 | | |
| | 1999 | 116.6 | | |
| | Av | 115.5 | 3.3 | 2.20 |
| MNH-329 | 1997 | 110.5 | | |
| | 1998 | 123.5 | | |
| | 1999 | 120.2 | | |
| | Av | 118.06 | 7.56 | 5.04 |
| MNH-93 | 1997 | 107.8 | | |
| | 1998 | 116.2 | | |
| | 1999 | 112.2 | | |
| | Av | 112.09 | 4.11 | 2.80 |

NAWF-5 stage; whereas CIM-1100 being late attained NAWF-5 stage after 119.5 DAP (Table 11). The late maturity of CIM-1100 was further confirmed from the values of percent first pick being 19.0, 16.0 and 18.0 for the year 1997, 199787 and 1999 respectively (Table 1,2,3).

The NAWF-5 values (Table 11) indicated that early maturing varieties required less number of days to reach the NAWF-5 stage and late maturing required higher number of days to achieve NAWF-5 stage. The rate of decreasing NAWF over time is shown by regression equation for varieties (Table 7,8,9). It is evident from these results that the $R^2$ values ranged between 0.82 to 0.99 suggesting that 82 to 99% variation in the NAWF is mainly due to number of days from planting and variation due to years was negligible. It is also observed that late maturing varieties tended to have higher intercept (a) and regression coefficients (b) than early maturing varieties. In early maturing varieties, white flower moves to the plant apex slightly faster than the late maturing ones. As

Table 12: Weekly flowering and boll retention per plant during 1997

| Varieties | | Week ending date 18/7 | 25/7 | 1/8 | 8/8 | 15/8 | 22/8 | 29/8 | 5/9 | 17/9 | 19/9 | 26/9 | 3/x | 10/x | 17/x |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reshmi | No. of flower | 0 | 0.1 | 0.5 | 1.2 | 2.8 | 8.1 | 14.4 | 11.2 | 5.7 | 2.9 | 2.9 | 1.6 | 0.1 | 0 |
| | No .of bolls | 0 | 0 | 0.3 | 0.7 | 0.3 | 1.6 | 2.1 | 1.5 | 0.9 | 0.5 | 0.2 | 0.1 | 0 | 0 |
| | Prog.Total | | 0 | 0.3 | 1.0 | 1.3 | 2.9 | 5.0 | 6.5 | 7.4 | 7.9 | 8.1 | 8.2 | 8.2 | 8.2 |
| CIM-443 | No. of flower | 0 | 0.1 | 0.3 | 0.6 | 0.9 | 5.8 | 15.7 | 20.7 | 18.3 | 13.0 | 10.5 | 6.5 | 3.1 | 0.2 |
| | No. of bolls | 0 | 0.1 | 0.3 | 0.5 | 0.2 | 0.3 | 4.5 | 5.4 | 4.5 | 3.2 | 2.1 | 0.1 | 0 | 0 |
| | Prog.Total | | 0.1 | 0.4 | 0.9 | 1.1 | 1.4 | 5.9 | 11.3 | 15.8 | 19.0 | 21.1 | 21.2 | 21.2 | 21.2 |
| N-78 | No. of flower | 0 | 0.1 | 0.4 | 0.6 | 1.0 | 5.2 | 14.7 | 18.7 | 16.5 | 12.1 | 8.2 | 5.3 | 2.8 | 0 |
| | No. of bolls | 0 | 0.1 | 0.2 | 0.4 | 0.4 | 0.5 | 3.5 | 5.1 | 4.2 | 2.2 | 1.2 | 0.2 | 0 | 0 |
| | Prog.Total | | 0.1 | 0.3 | 0.7 | 1.1 | 1.6 | 5.1 | 10.2 | 14.4 | 16.6 | 18.7 | 18.9 | 18.9 | 18.9 |
| S-12 | No. of flower | 0 | 0.2 | 2.5 | 3.7 | 4.9 | 11.2 | 11.8 | 11.4 | 12.0 | 9.0 | 9.5 | 4.3 | 0.7 | 0 |
| | No. of bolls | 0 | 0 | 0.1 | 1.1 | 2.1 | 4.3 | 5.4 | 6.4 | 5.0 | 3.3 | 1.4 | 0.3 | 0 | 0 |
| | Prog.Total | | 0 | 0.1 | 1.2 | 3.3 | 7.6 | 13.0 | 19.4 | 24.4 | 27.7 | 29.1 | 29.4 | 29.4 | 29.4 |
| FH-900 | No. of flower | 1.3 | 1.5 | 8.2 | 10.4 | 10.3 | 14.8 | 8.0 | 4.0 | 2.8 | 1.9 | 1.5 | 0 | 0 | 0 |
| | No. of bolls | 0 | 0.1 | 4.0 | 4.1 | 4.2 | 4.2 | 3.2 | 2.8 | 1.7 | 1.1 | 0.9 | 0 | 0 | 0 |
| | Prog.Total | | 0.1 | 4.1 | 8.2 | 12.4 | 16.6 | 19.8 | 22.6 | 24.3 | 25.4 | 26.3 | 26.3 | 26.3 | 26.3 |
| CIM-1100 | No. of flower | 0 | 0.1 | 1.4 | 2.4 | 4.0 | 5.4 | 6.7 | 5.4 | 5.4 | 3.8 | 2.3 | 3.5 | 4.3 | 1.7 |
| | No. of bolls | 0 | 0 | 0.8 | 1.5 | 2.1 | 3.4 | 3.9 | 2.8 | 3.1 | 1.8 | 1.1 | 0.5 | 0.2 | 0 |
| | Prog.Total | | 0 | 0.8 | 2.3 | 4.4 | 7.8 | 11.7 | 14.5 | 17.6 | 19.4 | 20.5 | 21.0 | 21.0 | 21.0 |
| MNH-439 | No. of flower | 0 | 1.5 | 6.9 | 14.4 | 11.5 | 13.0 | 9.1 | 8.6 | 2.9 | 1.5 | 1.6 | 0 | 0 | 0 |
| | No. of bolls | 0 | 0 | 0 | 1.2 | 2.5 | 2.8 | 2.2 | 2.4 | 2.0 | 1.1 | 0.5 | 0 | 0 | 0 |
| | Prog.Total | | 0 | 0 | 1.2 | 3.7 | 6.5 | 8.7 | 11.1 | 13.1 | 14.2 | 14.7 | 14.7 | 14.7 | 14.7 |
| MNH-395 | No. of flower | 0 | 1.4 | 5.6 | 13.2 | 12.8 | 15.3 | 12.2 | 14.5 | 10.5 | 5.6 | 3.2 | 1.4 | 0.5 | 0 |
| | No. of bolls | 0 | 0 | 1.5 | 2.3 | 2.9 | 3.5 | 3.6 | 2.7 | 2.3 | 1.4 | 1.1 | 0.5 | 0 | 0 |
| | Prog.Total | | 0 | 1.5 | 3.8 | 6.9 | 10.2 | 13.8 | 16.5 | 18.8 | 20.2 | 21.3 | 21.8 | 21.8 | 21.8 |
| MNH-329 | No. of flower | 0 | 0.8 | 2.1 | 4.2 | 5.6 | 9.5 | 11.3 | 10.1 | 7.8 | 6.8 | 4.5 | 2.1 | 0 | 0 |
| | No. of bolls | 0 | 0.2 | 1.2 | 2.1 | 2.0 | 3.2 | 3.5 | 2.6 | 1.8 | 1.5 | 0.6 | 0.2 | 0 | 0 |
| | Prog.Total | | 0.2 | 1.4 | 3.5 | 5.5 | 8.7 | 12.2 | 14.8 | 16.6 | 18.1 | 18.7 | 18.9 | 18.9 | 18.9 |
| MNH-93 | No. of flower | 0 | 0.7 | 1.8 | 3.0 | 4.2 | 8.3 | 10.1 | 9.6 | 6.7 | 9.1 | 8.6 | 6.9 | 3.4 | 0 |
| | No. of bolls | 0 | 0 | 0.5 | 2.1 | 3.0 | 3.1 | 6.2 | 2.5 | 1.5 | 1.4 | 1.5 | 0.5 | 0 | 0 |
| | Prog.Total | | 0 | 0.5 | 2.6 | 5.6 | 8.7 | 14.9 | 17.4 | 18.9 | 20.3 | 21.8 | 22.3 | 22.3 | 22.3 |

Table 13: Weekly flowering and boll retention per plant during 1998

| Varieties | | Week ending date 18/7 | 25/7 | 1/8 | 8/8 | 15/8 | 22/8 | 29/8 | 5/9 | 17/9 | 19/9 | 26/9 | 3/x | 10/x | 17/x |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reshmi | No. of flower | 0.1 | 0.8 | 1.2 | 2.5 | 3.1 | 10.2 | 16.5 | 13.5 | 3.6 | 2.1 | 1.8 | 0.5 | 0 | 0 |
| | No .of bolls | 0 | 0.3 | 0.4 | 1.2 | 2.1 | 4.6 | 5.2 | 6.2 | 1.5 | 0.5 | 0.1 | 0 | 0 | 0 |
| | Prog.Total | 0 | 0.3 | 0.7 | 1.9 | 4.0 | 8.6 | 13.8 | 20.0 | 21.5 | 22.0 | 22.1 | 22.2 | 22.2 | 22.2 |
| CIM-443 | No. of flower | 0.5 | 0.8 | 1.5 | 2.1 | 2.3 | 5.8 | 15.8 | 20.7 | 18.3 | 8.3 | 4.2 | 2.1 | 0.5 | 0.2 |
| | No. of bolls | 0.1 | 0.1 | 0.3 | 0.6 | 0.7 | 1.3 | 4.2 | 5.5 | 4.3 | 1.2 | 1.1 | 1.0 | 0.1 | 0 |
| | Prog.Total | 0.1 | 0.2 | 0.5 | 1.1 | 1.8 | 3.1 | 7.3 | 12.8 | 17.1 | 18.3 | 19.4 | 20.4 | 20.5 | 20.5 |
| N-78 | No. of flower | 0.3 | 0.6 | 1.4 | 2.6 | 2.5 | 5.2 | 14.7 | 18.7 | 16.5 | 11.2 | 4.1 | 1.3 | 0.5 | 0 |
| | No. of bolls | 0.2 | 0.1 | 0.3 | 0.5 | 0.4 | 1.5 | 3.6 | 5.2 | 4.6 | 2.2 | 1.3 | 0.1 | 0 | 0 |
| | Prog.Total | 0 | 0.3 | 0.6 | 1.1 | 1.5 | 3.0 | 6.6 | 11.8 | 16.4 | 18.6 | 19.9 | 20.0 | 20.0 | 20.0 |
| S-12 | No. of flower | 0 | 1.5 | 2.6 | 3.8 | 4.6 | 11.8 | 11.5 | 12.4 | 12.0 | 9.3 | 6.5 | 4.5 | 0.5 | 0 |
| | No. of bolls | 0 | 0.4 | 0.6 | 1.2 | 2.5 | 3.9 | 5.8 | 6.7 | 5.2 | 3.6 | 1.5 | 0.4 | 0.1 | 0 |
| | Prog.Total | 0 | 0.4 | 1.0 | 2.2 | 4.7 | 8.6 | 14.4 | 19.1 | 23.3 | 25.9 | 27.4 | 27.8 | 27.9 | 27.9 |
| FH-900 | No. of flower | 1.2 | 1.7 | 8.0 | 10.1 | 11.3 | 14.2 | 7.0 | 5.2 | 2.8 | 1.5 | 1.2 | 0.5 | 0 | 0 |
| | No. of bolls | 0.2 | 0.4 | 4.1 | 4.3 | 4.6 | 4.3 | 3.4 | 2.5 | 1.2 | 1.0 | 0.8 | 0 | 0 | 0 |
| | Prog.Total | 0 | 0.6 | 4.7 | 9.0 | 13.6 | 17.9 | 21.3 | 23.8 | 25.0 | 26.0 | 26.8 | 26.8 | 26.8 | 26.8 |
| CIM-1100 | No. of flower | 0 | 0.6 | 1.8 | 2.6 | 3.8 | 6.4 | 7.8 | 6.4 | 4.3 | 2.5 | 2.1 | 2.5 | 3.3 | 1.7 |
| | No. of bolls | 0 | 0.2 | 0.8 | 1.7 | 2.5 | 3.5 | 2.9 | 2.6 | 3.6 | 1.5 | 1.3 | 0.3 | 0.1 | 0 |
| | Prog.Total | 0 | 0.2 | 1.0 | 2.7 | 5.2 | 8.7 | 11.6 | 14.2 | 17.8 | 19.3 | 20.6 | 20.9 | 21.0 | 21.0 |
| MNH-439 | No. of flower | 0 | 2.5 | 5.9 | 13.2 | 10.5 | 11.0 | 8.1 | 7.5 | 3.9 | 1.2 | 1.6 | 0.5 | 0 | 0 |
| | No. of bolls | 0 | 0.5 | 1.2 | 1.4 | 2.7 | 3.8 | 2.6 | 2.0 | 1.5 | 1.0 | 0.5 | 0.1 | 0 | 0 |
| | Prog.Total | 0 | 0.5 | 1.7 | 3.1 | 5.8 | 9.6 | 12.2 | 14.2 | 15.7 | 16.7 | 17.2 | 17.3 | 17.3 | 17.3 |
| MNH-395 | No. of flower | 0.6 | 1.9 | 4.6 | 12.2 | 10.2 | 12.1 | 10.2 | 14.0 | 10.3 | 4.6 | 2.2 | 1.2 | 0.2 | 0 |
| | No. of bolls | 0.2 | 0.6 | 1.3 | 4.3 | 3.9 | 3.4 | 3.2 | 2.0 | 2.0 | 1.2 | 1.0 | 0.3 | 0 | 0 |
| | Prog.Total | 0.2 | 0.8 | 2.1 | 6.4 | 10.3 | 13.7 | 16.9 | 18.9 | 20.9 | 22.1 | 23.1 | 23.4 | 23.4 | 23.4 |
| MNH-329 | No. of flower | 0 | 1.8 | 3.1 | 4.8 | 6.7 | 10.5 | 11.0 | 8.2 | 6.3 | 3.2 | 3.1 | 1.8 | 0.3 | 0 |
| | No. of bolls | 0 | 0.3 | 1.4 | 2.5 | 2.5 | 3.1 | 3.2 | 2.4 | 3.1 | 1.8 | 0.5 | 0.1 | 0 | 0 |
| | Prog.Total | 0 | 0.3 | 1.7 | 4.2 | 6.7 | 9.8 | 13.0 | 15.4 | 18.5 | 20.3 | 20.8 | 20.9 | 20.9 | 20.9 |
| MNH-93 | No. of flower | 0.7 | 1.7 | 2.8 | 3.6 | 4.8 | 10.3 | 11.6 | 8.3 | 5.3 | 4.2 | 3.8 | 1.8 | 0.5 | 0 |
| | No. of bolls | 0 | 0.6 | 1.5 | 2.4 | 2.0 | 4.6 | 5.2 | 3.5 | 2.5 | 1.2 | 1.0 | 0.6 | 0 | 0 |
| | Prog.Total | 0 | 0.6 | 2.1 | 4.5 | 6.5 | 11.1 | 16.3 | 19.8 | 22.3 | 23.5 | 24.5 | 25.1 | 25.1 | 25.1 |

NAWF decreased the possibility of white flower producing a boll decreased, when NAWF value decreased to five (NAWF-5), boll retention, boll size, boll opening and boll maturity suffer drastically. It was also observed from weekly flowering and boll retention record (Tables 12, 13) that boll retention on the third and fourth week of September was almost nominal ranging from 0.2 to 2.1 during 1997 (Table 12) and 0.1 to 1.5 during third week of September 1998 (Table 13).

Correlation coefficient among seed cotton yield, percent first pick and days from planting to 5-node above white flower (days to NAWF-5) for varieties were computed (Table 10). Days to NAWF-5 was significantly and negatively correlated with percent first pick and seed cotton yield during all the years. Percent first pick was also significantly and positively correlated with seed cotton yield per plant during this period of study (Table 10). These results clearly suggested that early maturing varieties/genotypes contributed relatively higher percentage of yield early in the season and also produced over all more yield probably due to possible escape from boll worm attack. The pink boll worm damage was less in early maturing cotton varieties.

From the above study it was further concluded that technique of monitoring plant growth and boll development through counting NAWF can be efficiently used for the measurement of earliness in segregating populations and precise management of crop throughout the season for proper utilization and saving of irrigation water, fertilizer and pesticide for achieving optimum seed cotton yield.

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