

Studies on Prediction of Reproductive Phase in Maize (*Zea mays* L.)

Key words: Cob, Days after sowing, Number of Leaves Reproductive Growth, SCMR and Tassel.

Maize is an economically important crop because of its wide geographical distribution and commercial production as well as utilization. It is well known that nutrient deficiency in most of the cultivated crops during the reproductive growth season causes imbalances, leading to the reduction in yield. An essential macro nutrient like nitrogen plays a pivotal role in enhancement of photosynthetic assimilates and sink mobility as it was a chief constituent of chlorophyll molecule (Shaahan *et.al.*, 1999). SCMR (SPAD chlorophyll meter readings) do not indicate the quantity of nutrition required but it indicates the need of application (Earl and Tollenaar, 1997). Number of leaves on the stem and leaf chlorophyll content are Phenological indicators while correlating with its phenological reproductive growth stage (NeSmith and Ritchie 1992). The main objective of this study is to test whether the SCMR value and the corresponding leaf number can be effectively used to predict the reproductive stage of the maize crop, which requires nutrition for better assimilation.

A field experiment was conducted during *rabi* 2016-17 at Agricultural College Farm, Bapatla, using six maize hybrids as treatments 900Mgold, DKC 9142, DKC 9120, DKC 9081, DKC 9042 and Pinnacle, with four replications under randomized block design. SCMR (SPAD chlorophyll meter readings) values were measured by using SPAD-502, (Konica Minolta Japan) in fully expanded leaf of tagged plants at 7 days intervals for all the treatments. At every seven days interval the number of leaves were recorded in each hybrid, corresponding with each phenological stage was calculated days for tassel and cob initiation. The number of leaf primordial or reproductive primordial are examined and determined by dissecting the shoot tip at every leaf tip identified and the number of days to tassel and cob primordial initiation was recorded (Maurer *et al* 1966).

The correction factor for number of leaves determined through the time zero of initiation of leaf primordium "*n*" was determined by an increase in height of the meristematic dome above the last visible primordium which is "*n-1*" (NeSmith and Ritchie 1992). The number of fully expanded leaves also directly

measured to correlate the tassel and cob initiation in corresponding with number of days since the date of sowing. The data was analyzed by the analysis of variance (ANOVA) technique as suggested by Panse and Sukhatme (1978). The statistical hypothesis of equalities of treatment means was tested by the test in ANOVA at five percent level of significance to compare different treatment means

The results pertaining to number of leaves and SCMR values shown in Table 1 and 2 and also depicted in Fig. 1 at 7 DAS interval. The number of leaves for all the six maize hybrids from sowing to till harvest, increased in number ranging from 3 to 16 when observed from 7DAS to 91 DAS respectively. Among the hybrids, at 7 DAS Pinnacle and DKC 9142 significantly recorded highest leaf number (4) followed by DKC 9081 and DKC 9042 (3.5), whereas 900 M *gold* and DKC 9120 recorded the least number of leaves (3). At 14 DAS, a significant difference was observed in Pinnacle (7) which recorded the highest number of leaves followed by DKC 9142 (6.5), DKC 9120 (6.25). No significant difference was found between DKC 9081 and DKC 9042 (6) and the least number of leaves was observed in 900 M *GOLD* (5.5). Though a similar trend was observed for Pinnacle, DKC 9081, DKC 9042 and 900 M *GOLD* at 21 and 28 DAS, the trend slightly differed significantly for DKC 9120 and DKC 9142 where, the number of leaves were 7.75 and 7.5 respectively at 21 DAS and at 28 DAS, DKC 9142 recorded the highest (10.25) followed by pinnacle and DKC 9120 (10). A significant change was observed at 35 DAS, where the highest number of leaves were recorded for DKC 9142 followed by pinnacle, DKC 9120 and 900M *gold* which were on par with each other and the leaf number was recorded to be 10.75. The least number of leaves were observed for DKC 9042 (10) followed by DKC 9081 (9.75). At 42 DAS, pinnacle recorded the highest (12.5) followed by DKC 9142 (12.25), DKC 9042 (12); DKC 9120 and 900M *gold* were found to be on par (11.75) with each other and DKC 9081 recorded the least (11.5) number of leaves. From 49 DAS till harvest pinnacle and DKC 9142 were found to be on par and recorded the highest number of leaves. And

Table 1. Number of leaves of Six Maize Hybrids during 2016-17

HYBRIDS	7 DAS	14 DAS	21 DAS	28 DAS	35 DAS	42 DAS	49 DAS	56 DAS	63 DAS	70 DAS	77 DAS	84 DAS	91 DAS	Harvest
900MGOLD (V ₁)	3.00	4.25	6.15	8.75	10.75	11.75	13.00	14.25	14.75	15.75	15.75	15.75	15.75	15.75
DKC 9142 (V ₂)	3.75	5.50	7.10	10.25	11.50	12.25	13.75	14.50	15.00	16.00	16.00	16.00	16.00	16.00
DKC 9120 (V ₃)	3.00	5.25	6.65	10.00	10.75	11.75	13.25	14.00	14.50	15.50	15.50	15.50	15.50	15.50
DKC 9081 (V ₄)	3.50	5.00	6.00	9.00	9.75	11.50	13.25	13.75	14.00	15.00	15.00	15.00	15.00	15.00
DKC 9042 (V ₅)	3.50	5.00	6.50	9.00	10.00	12.00	13.00	14.25	14.50	15.00	15.00	15.00	15.00	15.00
Pinnacle (V ₆)	4.00	5.50	7.00	10.00	10.75	12.50	13.75	14.75	15.00	16.00	16.00	16.00	16.00	16.00
SEm+	0.29	0.29	0.26	0.19	0.35	0.43	0.29	0.35	0.34	0.23	0.23	0.23	0.23	0.23
CV%	12.09	6.73	5.18	2.93	4.77	5.19	3.16	3.54	3.36	2.11	2.11	2.11	2.11	2.11
CD(0.05)	0.63	0.63	0.57	0.42	0.76	0.93	0.63	0.76	0.74	0.49	0.49	0.49	0.49	0.49

Table 2. SCMR (SPAD METER READINGS) UNITS of Six Maize Hybrids during 2016-17

HYBRIDS	7 DAS	14 DAS	21 DAS	28 DAS	35 DAS	42 DAS	49 DAS	56 DAS	63 DAS	70 DAS	77 DAS	84 DAS	91 DAS	Harvest
900MGOLD (V ₁)	20.20	30.18	43.88	50.00	52.28	53.08	54.08	55.50	56.98	54.00	51.50	47.25	33.00	22.00
DKC 9142 (V ₂)	23.75	32.50	45.50	49.50	53.45	53.63	54.58	56.88	57.63	55.38	53.38	48.00	34.75	25.75
DKC 9120 (V ₃)	21.25	31.50	44.05	47.13	50.25	51.30	52.30	54.50	56.50	55.28	53.05	45.50	33.25	23.50
DKC 9081 (V ₄)	21.08	31.10	44.50	45.13	52.73	52.90	54.05	54.73	56.88	54.75	52.75	42.75	32.50	23.00
DKC 9042 (V ₅)	21.63	32.63	44.60	45.13	52.25	52.75	54.00	55.58	56.83	56.83	52.05	41.25	33.00	23.38
Pinnacle (V ₆)	23.50	32.75	45.00	50.75	53.60	53.85	54.50	55.25	57.25	56.88	54.50	45.50	34.50	25.50
SEm+	0.73	0.82	0.76	2.62	0.9	0.55	0.97	0.69	0.61	0.65	0.85	1.92	1.21	1.07
CV%	4.77	3.67	2.41	7.75	2.44	1.47	2.55	1.78	1.53	1.66	2.29	8.53	5.14	6.4
CD(0.05)	1.57	1.76	NS	5.6	1.93	1.17	2.07	1.48	NS	1.38	1.82	5.79	NS	2.28

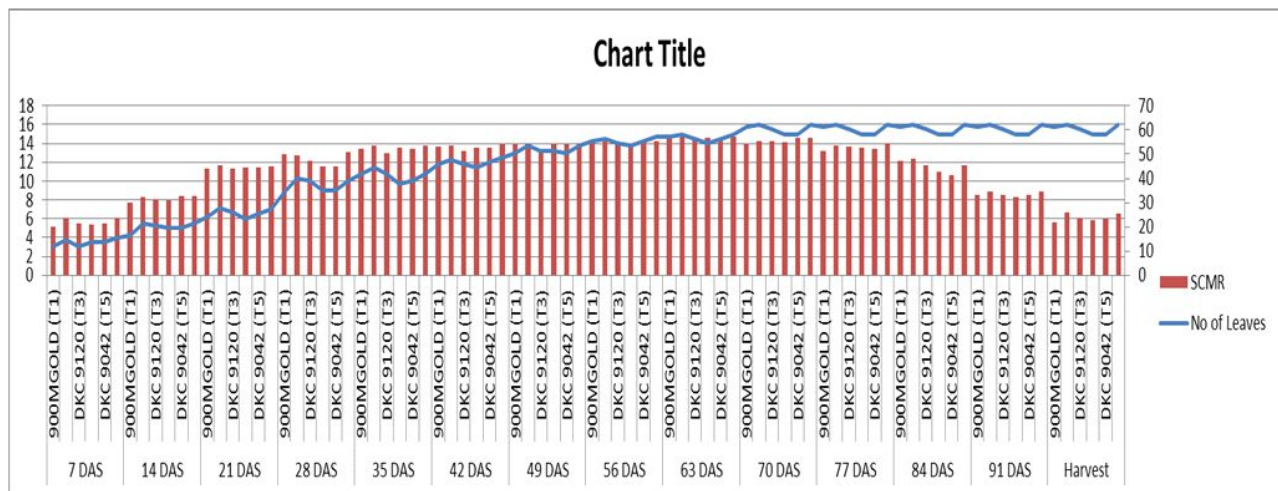


Fig 1. Relation between SCMR and Number of Leaves in Six Maize Hybrids.

from 70 DAS, the number of leaves remained the same until harvest irrespective of the hybrids. Pinnacle and DKC 9142 were found to be on par (16), followed by 900M gold (15.75), DKC 9120 (15.5); DKC 9081 and DKC 9042 were found to be on par (15) with each other and contain the least number of leaves among all the hybrids by the harvest time.

The number of leaves per plant and the leaf development is represented by the appearance and accumulation of leaves, which is an important part of vegetative development of maize crop. In maize, leaf development starts at emergence and ends with an appearance and expansion of final leaf number which is defined for all six maize hybrids *i.e.*; from the date of seedling emergence to 77DAS. In maize crop, vegetative development overlaps the reproductive stage, therefore leaf number is related to some reproductive developmental stages, such as tassel and ear initiation (Forsthofer *et al.*, 2004). Among the six maize hybrids, at 42DAS the stages vary among different hybrids based on number of leaves expanded; pinnacle (V12-12.50), DKC9142 (V12-12.25), DKC 9042 (V12-12.00), 900MGOLD (V11-11.75) and DKC 9081 (V11-11.50) (Forsthofer *et al* 2004). Several investigations have speculated that the phase identity of the maize plant after determination of leaf initiation. The age of the plant and physiological stage of the crop was determined by measuring the physical number of leaves on the stem (Joseph *et al.*, 2000). The rate of leaf appearance ultimately depends on the initiation of leaf primordial until the phase shifting from vegetative primordial transition to reproductive stage, *i.e.*, initiation of tassel and cob primordial differentiation in maize (Ne Smith and Ritchie, 1992). The time elapsing between sowing and silking is associated with the number of leaves per plant and the rate of leaf appearance (Earl and Tollenaar 1979).

From the reduction in increasing leaf number, it is evident that the silking date implies a reduction in plant size as per the results of crop grown in *rabi* during 2016-17 and 2017-18.

Significant differences were observed in all six maize hybrids during *rabi* 2016-17, at 7 DAS, DKC 9142 (23.75) and Pinnacle (23.50) recoded higher values, DKC 9081 also reached its SCMR value along with these two hybrids ranged from 32.50 to 32.75 at 14 DAS. Though the hybrids exhibited non-significant SCMR values till 35DAS, there was an increasing SCMR value was noticed with advancement of crop age. At 35 DAS, Pinnacle (53.60) followed by DKC 9142(52, 73), DKC 9081(52.28) and 900 M gold were recorded significantly higher values of SCMR. The same trend in SCMR values were carried upto 56 DAS, by increasing its value ranged from 52.30 to 54.50. However, maximum SCMR values were recorded by all six maize hybrids ranged from 53.50 to 57.63, but non-significant among the maize hybrids at 63 DAS and 70 DAS. Since 77 DAS to till harvest, reduction in SCMR values attributed to reduction in chlorophyll content, where reproductive phase shifting was completed and started to grain filling stage and physiological maturity. At 84 DAS, among all six maize hybrids Pinnacle and DKC 9142 showed their significance in SCMR up to harvest in decreasing trend. There is a correlation between number of leaves and in SCMR values that ultimately determines the stage phase shifting of the crop, where the highest number of leaves as well as high SCMR values were noticed at 35DAS. In maize, the intercalary meristem located between two previously differentiated tissues of certain organs that is nodes and internodes or between leaf blade and leaf sheath. The reproductive primordia differentiation ceases its further generation of new intercalary meristem for leaf development.

During 35 DAS, sharp increase in number of leaves and the SCMR values were hiked which indicates that the vegetative phase shift was initiated the reproductive phase and continued to increase until the completion of reproductive cycle of all six maize hybrids.

Among six maize hybrid pinnacle and DKC 9142 followed by other four hybrids, when the maximum number of leaves attained on the main stem the SCMR values also shown at higher levels thus it was assumed that the phase shifting of reproductive stage of respective hybrids.

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