**Leaf number index (LNI): A ready reckoner to identify the reproductive stage for nutrition of six Maize (*Zea mays L.)* hybrids**

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 **Abstract**

 Field experiments were carried to study the leaf number index of maize hybrids to identify the reproductive stage of six maize hybrids for application of nutrition at suitable time to improve more production. It was under taken at the Agricultural College farm, Bapatla during two consecutive years during *rabi* 2016-17 and 2017-18. In maize, leaf development starts at emergence and ends with the appearance and expansion of the flag leaf, when the final leaf number (FLN) is defined. In maize crop, the vegetative development overlaps the reproductive phase. The experiment was laid out in randomized block design with six maize hybrids as treatments in four replications. During both the seasons, tassel primordial initiation coincide with the 9th visible leaf in 900 M Gold and DKC 9081, 10th visible leaf in DKC 9142 and Pinnacle and 11th visible leaf in DKC 9120 and DKC 9042 with LNI of 54.54, 54.54, 53.77, 52.79, 54.62 and 54.62 respectively in the first season and 53.70, 54.71, 51.85, 53.70, 55.55 and 54.71 respectively in the second season.

**Key words: Leaf number index, leaf number, Vegetative development, reproductive**

 **phase , Tassel, ear, and ANOVA**

1. **Introduction**

Maize is the world’s third most important cereal crop after wheat and rice. The maize production in India is about 22 million tonnes with an area of 9.2 million hectare. Several experiments have been conducted to determine the growth stages of maize in a given environment. But, the basis for the variation in dry matter production and reproductive growth in relation to its foliage is less understood. The leaf growth that designates the physiological age of crop is more useful for crop improvement programmes.

 Leaf development, represented by the appearance and accumulation of leaves is an important part of the vegetative development of agricultural crops. In maize, leaf development starts at emergence and ends with the appearance and expansion of the flag leaf, when the final leaf number (FLN) is defined. In maize crop the vegetative development overlaps the reproductive phase. Maize is a *monoecious* crop, it differs in the pattern of initiation and development of pistillate as well as staminate flowers. The initiation of floral *primordia* corresponds to the time when a particular leaf from the top begins to elongate. The duration of floral primordia varies with the variety and weather condition. When the number of leaves to be developed on the stem is constant, the leaf number can be taken as a measure of physiological age of plant. This applies to photoperiod insensitive varieties and also to the same variety grown under the same environmental conditions (Bavec and Bavec12002).

 Leaf number (LN) is related to some reproductive developmental stages, such as tassel and ears initiation (Forsthofer6 *et al*., 2004). As leaf number increases, crop leaf area index (LAI) for net photosynthesis and crop biomass production (dry matter) also increases. Application of nutrients in maize is also related to leaf number (LN), being recommended at V4 (four expanded leaves), V7 (seven expanded leaves), and V11 (eleven expanded leaves) (Forsthofer6 *et al*., 2004). Thus any management practice or biotic or abiotic stresses that effect, the leaf development may potentially impact the reproductive growth and development, and ultimately influences the crop yield.

Matshushima10 (1980) introduced the idea of leaf number index (LNI) *i.e; Foliar Index* in rice crop to determine the panicle development stages in relation to leaf growth. The LNI explains much variation in leaf number. LNI is the number of leaves before heading divided by the number of days from sowing to heading and multiplied by 100. Leaf number index can be used as a tool to identify the tassel or cob differentiation age of that particular hybrid or variety of maize (Cao-bin4 *et al*., 2005). Thus the same analogy was applied, the leaf number index as tool for identification of reproductive phase in maize crop.

1. **Material and Methods**

The experiment was conducted in field number 8, Orchard block of Agricultural College farm, Bapatla. The farm is geographically located on the eastern side of the peninsular India, situated at an altitude of 5.49m above mean sea level,15°54' Northern latitude,80°25' Eastern longitude and about 7 km away from Bay of Bengal in Agro-climatic Zone III of Andhra Pradesh.

 **2.1 Number of leaves plant-1**

Leaf appearance rate was calculated on leaf tip (LN Tip) and on expanded leaf (LN expn) basis. A leaf was assumed expanded when ligule is visible.

The accumulated leaf number (LN) was calculated starting at crop emergence by calculating LAR was calculated as per Strek *et al*., 2009, presented in the following.

$$LN =∑LAR $$

Fiveplants were randomly selected and tagged in each plot after leaving boarder rows on all sides .The photosynthetic rate was recorded in the top most fully expanded leaf in the stem of the tagged plant at every seven days interval in all the treatments.

**2.2 Leaf number index (LNI)**

Leaf number Index is related to the developmental stage of growing reproductive part of the plant, this relationship holds the tassel or cob differentiation inside the plant. The physical appearance of the nth number of that particular stage can be explained by the expression of its index value by using the following formula (Mastishima9, 1976).

$$LNI=\frac{Number of leaves developed at particular time}{Number of leaves to be developed}×100 $$

Different hybrids / varieties vary in the number of leaves on the main stem. Hence, the leaf number index was corrected by using the correction factor (CF).

$$Correction factor \left(C.F.\right)=$$

=$\left(100-LNI\right)×\frac{maximum number of leaves attained-Total number ofleaves}{10}$

The corrected leaf number index then becomes:

$$Corrected leaf number index = Leaf number index + C.F$$

**2.3 Days to tasseling**

The number of days taken from date of sowing to the emergence of tassel from each plot was counted as number days for tasseling.

**2.4 Days to cob emergence /silking**

 The number of days taken from date of sowing to the emergence of cob in each plot was counted and expressed as days to silking.

**2.5 Anatomical observations**

Plants were sampled at completion of growth of every leaf and the initiation and growth of primordia of tassel and cob was observed anatomically in both the seasons and magnified

**2.6 Statistical Design:**

 The data were analyzed by following the analysis of variance (ANOVA) technique as suggested by Panse and Sukhatme14 (1978). The statistical hypothesis of equalities of treatment means was tested by the test in ANOVA at 5 percent level of significance to compare different treatment means.

1. **Results and Discussion**

 Maize is an economically important crop because of its widespread commercial production and utilization. It is well known that nutrient deficiency in most cultivated crops during the growth season causes imbalance, leading to low productivity and reduction in yield. Nutrient supply in critical stage of the crop, especially during the phase shift from vegetative phase to reproductive stage determines the crop productivity.

**3.1 Number of Leaves Plant-1**

The number of leaves in all hybrids from sowing to harvest increased from 3 to 16 (Table 1,2 and Fig. 1,2). During *rabi* 2016-17, among the hybrids at 7 DAS, Pinnacle and DKC 9142 significantly recorded the highest leaf number compared to DKC 9120, 900M Gold, which recorded the lowest and followed by DKC 9081 and DKC 9042, which inturn were also found on par with DKC 9120 and 900M Gold. At 14 DAS, 900M Gold had the leaf number lower than other five hybrids which were found on par with leaf number ranging from 5.0 to 5.5. At 21 and 28 DAS, DKC 9142, Pinnacle and DKC 9120 had the leaf number significantly higher than DKC 9081, 900M Gold and DKC 9042. At 35 DAS, leaf number was significantly less in DKC 9081 and DKC 9042 than other four hybrids which were found on par with leaf number ranging from 10.8 to 11.5. At 42 DAS, Pinnacle recorded significantly more number of leaves than DKC 9081, which had the less and on par with DKC 9142, DKC 9042, DKC 9120 and 900M Gold, which in turn also showed parity with DKC 9081. At 49 DAS, Pinnacle and DKC 9142 had the leaf number greater than DKC 9042, 900M Gold and on par with DKC 9120, DKC 9081 which showed parity also with DKC 9042 and 900M Gold. At 56 DAS, Pinnacle had more leaf number, significantly greater than DKC 9081, DKC 9120 and on par with DKC 9142, DKC 9042 and 900M Gold, which were also on par with DKC 9081. Later at 63 DAS, Pinnacle, DKC 9142 and 900M Gold had significantly more leaf number than DKC 9081 and these four hybrids were found on par with DKC 9042 and DKC 9120. Finally at 70 DAS to harvest, leaf number was significantly high in pinnacle, DKC 9142 and 900M Gold compared to other three hybrids. All hybrids attained the maximum leaf number in 70 calendar days after sowing with cumulative heat units of about 1028 °Cd.

During *rabi* 2017-18, for second season of the experiment among the maize hybrids, Pinnacle (3.8) expressed its dominance in leaf development at 7 DAS and continued upto 49 DAS along with another hybrid DKC 9142 (Table 4.6). At 7 DAS leaf number plant-1 varied from 3.0 to 3.8, Pinnacle and DKC 9142 had the leaves significantly greater than DKC 9042 and on par with other three hybrids. At 14 DAS, Pinnacle and DKC 9142 had the leaves significantly more in number. The increase in leaf number simultaneously continued along with crop age and architecture, where from 14 DAS to 35 DAS ranged between 5.75 (900M Gold) to 11.75 (Pinnacle). From 49 DAS to 63 DAS the same trend was shown by six hybrids and the maximum number of leaves were attained at 70 DAS by recording 16 leaves per plant.

In summary, the results indicated that during both the seasons, leaf number was found high in Pinnacle and DKC 9142 and low in DKC 9081 and DKC 9042. The other two hybrids (DKC 9120, 900M Gold) possessed comparatively less number of leaves during very early and some other days of observation, while during the grand growth period of leaf emergence (21 to 49 DAS), these two hybrids attained the leaf number on par with Pinnacle and DKC 9142. The number of leaf whorl expansion varies with hybrid and the rate of appearance and number was determined primarily by temperature and leaf development rates which were linearly related to accumulated heat units expressed as growing degree days (Padilla and Otegue13, 2005).

Leaf development, represented by the appearance and accumulation of leaves is an important part of the vegetative development of agricultural crops. In maize, leaf development starts at emergence and ends with the appearance and expansion of the flag leaf, when the final leaf number is defined. In this crop, vegetative development overlaps the reproductive one. Therefore, leaf number is related to some reproductive developmental stages, such as ears and tassel initiation (Forsthofer6 *et al*., 2004).

In the present investigation, at early stages of crop growth (14 DAS), the hybrids studied except 900M Gold possessed almost the similar leaf number and all attained the maximum number leaves at 70 DAS. This indicated that it is the stage at which the final leaf number is defined and is varied from 15.0 to 16.0. during the period of 14 to 70 DAS, the increment in cumulative heat units was 807.4 °Cd and the increment in leaf number was 11.5 for the hybrids DKC 9142, Pinnacle and 900M Gold, 10.25 for DKC 9120 and 10.0 for DKC 9081 and DKC 9042. For all hybrids under study, the leaf appearance rate was found maximum during the period of 21 to 28 DAS.

**3.2. Leaf Number Index (LNI)**

Leaf number index of six maize hybrids varied significantly, increased with age of the crop (Table3, 4 and Fig. 3,4). In *rabi* 2016-17, at 7 DAS, LNI was significantly high in Pinnacle, low in DKC 9120 and 900 M Gold compared to DKC 9081 and DKC 9042. At 14 DAS, the hybrids V2 to V6 were on par, had LNI greater than 900M Gold. At 21 DAS, it was high in DKC 9142 and low in DKC 9081 and 900M Gold compared to DKC 9120, DKC 9042 which showed parity with Pinnacle. At 35 DAS, LNI was low in DKC 9081 followed by DKC 9120 and high in DKC 9142 followed by 900M Gold. It was intermediate in other two and on par. At 42 DAS, DKC 9042 had high LNI followed by Pinnacle and 900M Gold had low LNI followed by DKC 9120 and the other two had the value in between and were on par. At 49 DAS, DKC 9081 had high LNI followed by DKC 9042 and 900M Gold had low LNI, the other three were in between. At 56 DAS, DKC 9042 had high LNI value followed by Pinnacle which showed parity with DKC 9081 and 900M Gold, DKC 9120 had low value of LNI followed by DKC 9142. Later at 63 DAS, all hybrids had low LNI compared to DKC 9042 and further all were equal. The magnitude of increase in LNI was more from 21 to 28 DAS.

In *rabi* 2017-18 also, LNI of maize hybrids varied significantly. At 7 DAS, it was high in DKC 9142, Pinnacle followed by DKC 9120 and low in DKC 9042 followed by 900M Gold. At 14 DAS, along with DKC 9142 and Pinnacle, DKC 9042 also had high LNI, followed by DKC 9120 compared to DKC 9081 and 900M Gold. At 21 DAS, DKC 9142 and Pinnacle maintained the domination followed by DKC 9120, 900M Gold and less in other two. At 28 DAS, compared to 900M Gold and DKC 9042, other hybrids had LNI on par. At 35 DAS, Pinnacle had high LNI followed by DKC 9142. The low LNI was noticed in DKC 9081 followed by DKC 9042 and other two had the value in between. At 42 DAS, compared to V1, V4 and V5, DKC 9142 had high LNI followed by Pinnacle and DKC 9120. At 49 DAS, Pinnacle had high and DKC 9120 had low compared to other hybrids. Finally at 56 DAS, Pinnacle and 900M Gold followed by DKC 9142 showed domination over other three. The magnitude of increase in LNI was more at 7 to 14 DAS for DKC 9142, DKC 9042, Pinnacle; at 21 to 28 DAS for DKC 9081 and at 28 to 35 DAS for 900M Gold and DKC 9120.

The appearance of leaf is depended on genetical potential and respond to the photoperiod and temperature (Nesmith and Ritchie11, 1992). The final leaf number (FLN) depends on the rate and duration of leaf initiation. The rate is usually calculated from the quotient of the number of leaves produced from sowing until tassel initiation and time elapsed between those events taking into account the number of leaves already present in the embryo (Padilla and Otegui13, 2005). According to Tollenaar18 *et al* (1979) the phase shift from vegetative stage to reproductive phase was initiated at 35 DAS, where the reproductive tissue (tassel and cob) differentiation occurs.

 In the present investigation, for the hybrids studied, the phase shift from vegetative to reproductive was initiated at 28 DAS to 34 DAS. The number of days to tassel primordial initiation varied from 28.5 to 30.0 DAS in both the seasons. Whereas the number of days to initiation of cob development varied from 32.25 to 33.0 in *rabi* 2016-17 and 31.13 to 34.0 in *rabi* 2017-18. The LNI at the time of primordial initiation for tassel and cob development lies between 55.4 to 73.9. Cao – Bin4 *et al.* (2005) reported that the corresponding LNI for the tassel and cob development ranged from 55 to 98. During both the seasons, the visible leaf number that coincides with initiation of tassel development varied from 9th to 11th depending on hybrid and that of cob varied from 10th to 11th leaf. This indicates that the phase shift from vegetative to reproductive coincides with the visible leaf number 9th to 11th.

Cao – Bin4 *et al.* (2005) observed the development of reproductive organs anatomically and reported that the development of reproductive organs progressed during 42 to 49 DAS. Streck17 *et al.* (2009) observed the complete heading of tassel and silking of the cob, an important stage for anthesis during 56 to 63 DAS. He reported that it coincides with visible leaf number 14th to 15th with LNI of 90 to 99. Tollenaar18 *et al* (1979) stated that maximum LNI value 100 represents the completion of the reproductive cycle of the plant and it is attained at 77 DAS corresponding to attainment of final leaf number, the translocation of assimilates is continued for maturation of grain. The results of present investigation are in confirmation with these reports. But the final leaf number and maximum LNI were attained at 70 DAS.

**3.3 Days to Tassel Initiation and Emergence**

The shoots of maize become determinate or limited in growth by the differentiation of the shoot apical meristem into the terminal inflorescence, the tassel. During vegetative growth, the meristem initiates a predictable number of leaf primordia. Once all vegetative nodes have been initiated, the meristem changes its pattern of development and begins to initiate primordia that will ultimately give raise to florets, in which such specialized process such as sex determination, meiosis and microsporogenesis takes place (Bonnett2, 1948, Kiesselbach8., 1949 and Sass16, 1976). The meristem is ultimately consumed in the process of initiating primordial, so that the extent of growth of the shoot becomes limited.

Number of days for tassel initiation and emergence were measured during both seasons *rabi* 2016-17 and 2017-18 (Table 5). Tassel development was observed anatomically by dissecting the plants starting from two color stage (fourth visible leaf) at every leaf whorl expansion (Plate No 1 to 4). The number of days to tassel primordial initiation varied from 28.50 DAS to 30.00 DAS. DKC 9142 (28.50) took significantly less number of days (28.50) to tassel initiation, followed by Pinnacle (29.0), DKC 9142 (29.25), DKC 9120 (29.50) which in turn were on par with DKC 9081 (29.75). The hybrid 900M Gold took relatively more number of days (30.0), on par with DKC 9120, DKC 9081 and differed with other three. Days to tassel emergence observed was 42 DAS and it is same for all hybrids.

By the time of tassel primordial initiation, the heat units accumulated was 467.0 for DKC 9142, 481.6 for pinnacle, DKC 9042 and DKC 9120 and 498.0 for DKC 9081 and 900M Gold during *rabi* 2016-17. The heat units accumulated by the time of tassel emergence were 632.8. During *rabi* 2017-18 (Table 4.9), DKC 9120 (30.00) took more number of days for tassel initiation followed by 900M Gold (29.38), Pinnacle (29.38), DKC 9081 (29.25) and DKC 9142 (28.38) took less number of days for tassel initiation followed by DKC 9042 (29.00).

During *rabi* 2017-18, by the time of tassel primordial initiation, the heat units accumulated was 488.7 for DKC 9142 and DKC 9042, 503.3 for Pinnacle and 900M Gold, 503.8 for DKC 9120 and 517.6 for DKC 9081. During both the seasons, tassel primordial initiation coincides with the 9th visible leaf in 900M Gold and DKC 9081, 10th visible leaf in DKC 9142 and Pinnacle and 11th visible leaf in DKC 9120 and DKC 9042 and the corresponding LNI is 52.72 to 54.62.

Most lines of maize are classified as quantitative short day plants, thus the conversion from vegetative development to flowering can be influenced by environmental conditions (Hanway and Ritchie7, 1985). Environmental variables, such as temperature and photoperiod can have a major effect controlling both the rate and duration of many of these developmental events (Warrington and Kanemasu19, 1983). The number of days for tassel initiation or cob development also dependent on the required thermal units or growing degree days to determine the time for floral initiation (Cross and Zuber5, 1972). Heat units or Growing degree days are widely used for maturity classification of commercial hybrids and are used to determine the suitability for particular geographical locations, in particular they are used for predicting the ontogeny of maize hybrids especially the flowering time the same statement confirmed by the findings of Tollenaar18 *et al.* (1979), Cross and Zuber (1972) and Hanway and Ritchie7 (1985).

**3.4. Days to Cob Initiation and Emergence**

During the period of crop growth in both *rabi* 2016-17 and 2017-18, cob or ear development was observed anatomically by dissecting at each leaf expression of the plant and number of days to cob initiation was assessed.

Axillary shoots developed in acropetal succession and during the early stage of the development the axillary shoots became larger in succession from the apex to the base of the stem. At later stages development, axillary shoots are no longer produced. The cessation of axillary shoot development seems to be associated with the elongation and development of internodes of the stem and development of the cob. This is similar to the observations made by Mastushima10 (1980) in rice, Percival 15(1921) in wheat and Bonnett 3(1975) in maize. In *rabi* 2016-17, the lowest number of days to develop the ear or cob was found in DKC 9142 (32.25) followed by DKC 9120 (32.50) DKC 9042 (32.50) and Pinnacle (33.00). Whereas, during the second season *i.e.*; 2017-18, DKC 9042 (31.13) recorded less number of days for cob development, followed by DKC 9081(32.00), Pinnacle (32.13), 900M Gold (32.63) and DKC 9042 (34.00). These results were similar to the observations reported by Nielsen12 *et al.* (2002).

During *rabi* 2016-17, cob initiation coincided with visible leaf number 10 in DKC 9042 and DKC 9081, visible leaf number 10.75 in DKC 9120 and 900M Gold and visible leaf number 11.50 in DKC 9142 and Pinnacle with LNI of 59.29, 60.63 and 63.60 respectively and the thermal units required varied from 467 to 498 ℃d.

An axillary meristem forms at each node, (behind the leaf sheath) beginning at the base of the stalk and continuing towards the top. Each axillary meristem initiates husk leaves at the nodes of the ear shank and eventually an ear itself at the tip of the ear shank. The growing point of (apical meristem) the maize plant finishes the task of initiating leaf primordial and completes its developmental responsibilities by initiating the tassel primordium of the plant. At about the same time, the tassel is initiated and the uppermost harvestable (final leaf) ear is also initiated (Lejeune and Bernier8a, 1996). During *rabi* 2017-18, the ear or cob development initiation coincides with 10th to 11th visible leaf number corresponding LNI is 58.49 to 64.15 and thermal unit requirement is 488.70 to 517.55 °Cd.

Ear development from upper one or more axillary shoots of the stem may remain nonfunctional or develop into suckers. The top most shoots, whether they are single or multiple ear types, in turn take precedence in their development or they may inhibit the development of lower shoots immediately. Cob or ear differentiation is indicated by an elongation of the growing point of the axillary shoot and the differentiation of lateral projections from the central axis of the cob or ear differentiation. The lateral projections are the initials from which the spikelet initials differentiate and corresponding to the initials that first appear on the central axis and branches of the tassel, and subtending leaf initials that appear on the differentiation of inflorescence by forming the micro ridges, which gradually increase in size and form a cup like depressions in which spikelet initials occurs. Spikelet initials are proceeded in pairs by division into two unequal parts .While the parts of larger of the pair of the spikelet initials, begin to differentiate before those of the smaller spikelet initial, the difference in the development is not so great as was pointed out for the spikelet initials of the tassel.

The early glumes of the spikelet parts undergone to form transverse ridges across the spike let initials, in more advance the early glumes increase in length enclose with the ovary, but the projections of the style (silk) that extend beyond the cob length (Bonnet3, 1996).

1. **Conclusions**

 The results of present investigation are in confirmation with these reports. But the final leaf number and maximum LNI were attained at 70 DAS. The results revealed that, maize hybrids i.e., 900M Gold, DKC 9142, DKC 9120, DKC 9081, DKC 9042 and Pinnacle, the maximum values of number of leaves were attained in maize hybrids at 77 DAS, with corresponding GDD of 1135.7 and 1130.7 for both the seasons respectively. Leaf Number Index (LNI) is the ready reckoner to identify the reproductive phase shift of maize hybrids for tassel and cob initiation, where LNI ranged from 54.63 to 73.86 with corresponding visible leaf number from 9th to 11th. LNI value was attained100 at 77 DAS, with maximum visible leaf number16 in six maize hybrids, is an indication for peak stage of growth. Hence, based on this present investigation, number of days for tassel and cob initiation and development among maize hybrids was observed between 28.0 to 34.0 DAS the LNI ranged from 54.63 to 73.86 with corresponding visible leaf number from 9th to 11th. Instead of split dose application of nitrogen at 30 to 35 DAS, 28 to 30 DAS, is more effective, where the flowering phase initiated, varied with hybrid for better crop productivity.

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**Conflict of interest**

The authors declare that they have no conflict of interest.

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**Figure 1 Tassel Initiation of DKC 9081**



 

**Figure 3 Close view of Cob Initiation after dissection of DKC 9081**

**A.** 

**B.** 

**Plate 5 A & B Tassel Initiation in DKC 9042**

**A.** 

**B**. 

**Plate 6 A & B Cob Initiation in DKC 9042**



**Plate 7 Tassel Initiation of Pinnacle**



**Plate 8 Close View of Tassel Initiation of Pinnacle**



**Plate 9 Cob Initiation of Pinnacle**



**Table 1 Number of leaves in maize hybrids during *rabi* 2016-17**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Days After Sowing** | **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** |
| **GDD** | **114.9** | **220.2** | **334.8** | **434.9** | **541.4** | **632.8** | **730.7** | **829.6** | **929.2** | **1027.6** | **1135.7** | **1236.2** | **1338.7** | **1447.5** |
|  **Hybrids** |
| **900MGold (V1)** | 3.0 | 4.2 | 6.2 | 8.8 | 10.8 | 11.8 | 13.0 | 14.3 | 14.8 | 15.8 | 15.8 | 15.8 | 15.8 | 15.8 |
| **DKC 9142 (V2)** | 3.8 | 5.5 | 7.1 | 10.2 | 11.5 | 12.3 | 13.8 | 14.5 | 15.0 | 16.0 | 16.0 | 16.0 | 16.0 | 16.0 |
| **DKC 9120 (V3)** | 3.0 | 5.2 | 6.6 | 10.0 | 10.8 | 11.8 | 13.3 | 14.0 | 14.5 | 15.5 | 15.5 | 15.5 | 15.5 | 15.5 |
| **DKC 9081 (V4)** | 3.5 | 5.0 | 6.0 | 9.0 | 9.8 | 11.5 | 13.3 | 13.8 | 14.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 |
| **DKC 9042 (V5)** | 3.5 | 5.0 | 6.5 | 9.0 | 10.0 | 12.0 | 13.0 | 14.3 | 14.5 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 |
| **Pinnacle (V6)** | 4.0 | 5.5 | 7.0 | 10.0 | 10.8 | 12.5 | 13.8 | 14.8 | 15.0 | 16.0 | 16.0 | 16.0 | 16.0 | 16.0 |
| **SEm±** | 0.29 | 0.29 | 0.26 | 0.19 | 0.35 | 0.43 | 0.29 | 0.35 | 0.34 | 0.23 | 0.23 | 0.232 | 0.232 | 0.232 |
| **CD (p=0.05)** | 0.63 | NS | 0.57 | 0.42 | 0.76 | 0.93 | 0.63 | 0.76 | 0.74 | 0.49 | 0.49 | 0.49 | 0.49 | 0.49 |
| **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 |

**Table 2 Number of leaves in maize hybrids during *rabi* 2017-18**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Days After Sowing** | **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** |
| **GDD** | **141.6** | **253.4** | **352.5** | **457.3** | **557.7** | **653.6** | **748.5** | **838.6** | **942.5** | **1032.7** | **1130.7** | **1226.8** | **1334.9** | **1424.8** |
|  **Hybrids** |
| **900MGold (V1)** | 3.3 | 5.8 | 7.3 | 8.8 | 11.0 | 12.3 | 13.8 | 15.5 | 15.8 | 16.0 | 16.0 | 16.0 | 16.0 | 16.0 |
| **DKC 9142 (V2)** | 3.8 | 6.0 | 7.8 | 9.8 | 11.3 | 12.8 | 14.5 | 15.8 | 16.0 | 16.0 | 16.0 | 16.0 | 16.0 | 16.0 |
| **DKC 9120 (V3)** | 3.5 | 5.5 | 7.3 | 8.8 | 10.5 | 12.3 | 13.3 | 14.5 | 15.5 | 15.8 | 15.8 | 15.8 | 15.8 | 15.8 |
| **DKC 9081 (V4)** | 3.3 | 5.0 | 6.8 | 8.8 | 10.3 | 11.8 | 13.3 | 14.5 | 15.3 | 15.5 | 15.5 | 15.5 | 15.5 | 15.5 |
| **DKC 9042 (V5)** | 3.0 | 5.8 | 6.8 | 8.5 | 10.5 | 11.8 | 13.5 | 14.5 | 15.3 | 15.5 | 15.5 | 15.5 | 15.5 | 15.5 |
| **Pinnacle (V6)** | 3.8 | 6.0 | 7.8 | 9.8 | 11.8 | 12.8 | 14.8 | 15.8 | 16.0 | 16.0 | 16.0 | 16.0 | 16.0 | 16.0 |
| **SEm±** | 0.28 | 0.26 | 0.45 | 0.37 | 0.35 | 0.47 | 0.36 | 0.40 | 0.24 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 |
| **CD (p=0.05)** | 0.61 | 0.57 | 0.979 | 0.806 | 0.757 | NS | 0.778 | 0.870 | 0.520 | NS | NS | NS | NS | NS |
| **CV%** | 11.94 | 6.16 | 8.96 | 5.91 | 4.62 | 5.44 | 3.73 | 3.82 | 2.21 | 2.28 | 2.28 | 2.28 | 2.28 | 2.28 |

**Fig. 1 Number of leaves in maize hybrids during *rabi* 2016-17**

**Fig. 2 Number of leaves in maize hybrids during *rabi* 2017-18**

 **Table 3 Leaf number index (LNI) of maize hybrids during *rabi* 2016-17**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Days After Sowing** | **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** |
| **900MGold (V1)** | 20.3 | 28.2 | 40.0 | 56.3 | 68.8 | 75.0 | 82.8 | 90.6 | 93.8 | 100.0 | 100.0 | 100.0 | 100.0 |
| **DKC 9142 (V2)** | 24.7 | 35.4 | 45.3 | 64.6 | 73.9 | 76.9 | 86.2 | 90.8 | 93.9 | 100.0 | 100.0 | 100.0 | 100.0 |
| **DKC 9120 (V3)** | 20.6 | 34.8 | 43.8 | 63.1 | 66.8 | 76.2 | 85.7 | 90.5 | 93.6 | 100.0 | 100.0 | 100.0 | 100.0 |
| **DKC 9081 (V4)** | 24.5 | 33.4 | 40.9 | 60.1 | 65.5 | 77.0 | 88.5 | 91.8 | 93.4 | 100.0 | 100.0 | 100.0 | 100.0 |
| **DKC 9042 (V5)** | 24.5 | 33.4 | 44.2 | 60.1 | 67.2 | 80.3 | 86.9 | 95.1 | 96.7 | 100.0 | 100.0 | 100.0 | 100.0 |
| **Pinnacle (V6)** | 26.0 | 35.4 | 44.7 | 63.1 | 67.7 | 78.5 | 86.2 | 92.2 | 93.9 | 100.0 | 100.0 | 100.0 | 100.0 |
| **SEm±** | 0.09 | 1.32 | 0.53 | 4.27 | 0.18 | 0.27 | 0.33 | 0.58 | 0.51 |  |  |  |  |
| **CV%** | 0.59 | 10.37 | 6.81 | 10.62 | 0.37 | 0.51 | 0.56 | 0.89 | 0.77 |  |  |  |  |
| **CD (p=0.05)** | 0.21 | 2.69 | 1.13 | NS | 0.39 | 0.53 | 0.72 | 1.23 | 1.09 |  |  |  |  |

 **Table 4 Leaf number index (LNI) of maize hybrids during *rabi* 2017-18**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  **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** |
| **900MGold (V1)** | 21.6 | 33.0 | 46.2 | 55.4 | 69.3 | 76.9 | 85.9 | 96.1 | 98.5 | 100.0 | 100.0 | 100.0 | 100.0 |
| **DKC 9142 (V2)** | 24.7 | 38.5 | 49.3 | 61.6 | 70.8 | 80.0 | 90.8 | 94.5 | 98.6 | 100.0 | 100.0 | 100.0 | 100.0 |
| **DKC 9120 (V3)** | 23.4 | 35.9 | 46.9 | 56.3 | 69.3 | 78.1 | 84.4 | 92.8 | 98.14 | 100.0 | 100.0 | 100.0 | 100.0 |
| **DKC 9081 (V4)** | 22.2 | 33.4 | 44.4 | 57.1 | 66.6 | 76.2 | 85.7 | 93.5 | 98.6 | 100.0 | 100.0 | 100.0 | 100.0 |
| **DKC 9042 (V5)** | 20.6 | 38.1 | 44.4 | 55.5 | 68.2 | 76.2 | 87.3 | 93.6 | 98.4 | 100.0 | 100.0 | 100.0 | 100.0 |
| **Pinnacle (V6)** | 24.6 | 38.5 | 49.3 | 61.6 | 73.9 | 78.1 | 92.3 | 96.5 | 98.9 | 100.0 | 100.0 | 100.0 | 100.0 |
| **SEm±** | 0.10 | 0.53 | 0 .53 | 3.25 | 0.20 | 0.25 | 0.48 | 0.68 | 0.25 |  |  |  |  |
| **CV%** | 0.45 | 1.43 | 5.81 | 10.68 | 0.45 | 0.78 | 0.68 | 0.96 | 0.65 |  |  |  |  |
| **CD (p=0.05)** | 0.29 | 2.10 | 1.03 | 5.59 | 0.85 | 0.68 | 0.89 | 1.03 | NS |  |  |  |  |

 **Leaf number index (LNI) of maize hybrids during *rabi* 2016-17**

 **Leaf number index (LNI) of maize hybrids during *rabi* 2017-18**

**Table 5 Days to tassel and cob initiation of maize hybrids during *rabi* 2016-17 and 2017-18**

|  |  |  |
| --- | --- | --- |
| **Hybrids** | **During *rabi* 2016-17** | **During *rabi* 2017-18** |
| **Days to tassel initiation** | **Days to cob initiation** | **Days to tassel initiation** | **Days to cob initiation** |
| **900MGold (V1)** | 30.00 | 34.75 | 29.38 | 32.63 |
| **DKC 9142 (V2)** | 28.50 | 32.25 | 28.38 | 32.00 |
| **DKC 9120 (V3)** | 29.50 | 32.50 | 30.00 | 32.75 |
| **DKC 9081 (V4)** | 29.75 | 34.75 | 29.25 | 34.00 |
| **DKC 9042 (V5)** | 29.25 | 32.50 | 29.00 | 31.13 |
| **Pinnacle (V6)** | 29.00 | 33.00 | 29.38 | 32.13 |
| **SEm±** | 0.32 | 0.32 | 0.36 | 0.53 |
| **CD (p=0.05)** | 0.69 | 0.68 | 0.77 | 1.14 |
| **CV%** | 1.56 | 1.37 | 1.75 | 2.34 |